DOCUMENT RESUME

ED 258 034 CE 041 762

TITLE	Crane and Excavator Operator.
INSTITUTION	Marine Corps Inst., Washington, DC.
REPORT NO	MCI-13.52a
PUB DATE	25 May 83
NOTE	107p.; Some figures will not reproduce well.
PUB TYPE	Guides - Classroom Use - Materials (For Learner) (051)
EDRS PRICE	MF01/PC05 Plus Postage.
DESCRIPTORS	Adult Education; Behavioral Objectives; *Building Trades; Continuing Education; *Correspondence Study; Course Descriptions; *Equipment Maintenance; *Equipment Utilization; Individualized Instruction; Learning Activities; Military Training; *Operating Engineering; Study Guides; Technical Occupations; Trade and Industrial Education
IDENTIFIERS	*Heavy Equipment Operators

ABSTRACT

Developed as part of the Marine Corps Institute (MCI) correspondence training program, this course on crane and excavator operation is designed to enable the crane and excavator operator to perform his/her duties more proficiently. Introductory materials include specific information for MCI students, a course introduction, and a study guide (guidelines to complete the course). The 13-hour course contains four study units. Each study unit begins with a general objective. The study units are divided into numbered work units, each presenting one or more specific objectives. Contents of a work unit include a text and study questions/exercises. Answer keys are found at the end of each study unit. At the end of the course is a review lesson. Topics covered in the study units include crane and excavator operator, attachments and wire rope, safety, and operator maintenance. (YLB)

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UNITED STATES MARINE CORPS
MARINE CORPS INSTITUTE, MARINE BARRACKS
BOX 1775
ARLINGTON, VA. 22222

13.52a

15 MAY 1983

1. ORIGIN

MCI Course 13.52a, Crane and Excavator Operator, has been prepared by the Marine Corps Institute.

2. APPLICABILITY

This course is for instructional purposes only.

J. M. D. HOLLADAY
Lieutenant Colonel, U. S. Marine Corps
Deputy Director

ACKNOWLEDGMENT

The Marine Corps Institute, Marine Barracks, Washington, D.C. gratefully acknowledges the important contribution provided by the following MCI personnel in developing and publishing this course:

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INFORMATION

FOR

MCI STUDENTS

Welcome to the Marine Corps Institute training program. Your interest in self-improvement and increased professional competence is commendable.

Information is provided below to assist you in completing the course. Please read this guidance before proceeding with your studies.

1. MATERIALS

Check your course materials. You should have all the materials listed in the "Course Introduction." In addition you should have an envelope to mail your review lesson back to MCI for grading unless your review lesson answer sheet is of the self-mailing type. If your answer sheet is the pre-printed type, check to see that your name, rank, and social security number are correct. Check closely, your MCI records are kept on a computer and any discrepancy in the above information may cause your subsequent activity to go unrecorded. You may correct the information directly on the answer sheet. If you did not receive all your materials, notify your training NCO. If you are not attached to a Marine Corps unit, request them through the Hotline (autovon 288-4175 or commercial 202-433-4175).

2. LESSON SUBMISSION

The self-graded exercises contained in your course are not to be returned to MCI. Only the completed review lesson answer sheet should be mailed to MCI. The answer sheet is to be completed and mailed only after you have finished all of the study units in the course booklet. The review lesson has been designed to prepare you for the final examination.

It is important that you provide the required information at the bottom of your review lesson answer sheet if it does not have your name and address printed on it. In courses in which the work is submitted on blank paper or printed forms, identify each sheet in the following manner:

DOE, John J. Sgt 332-11-9999
08.4g, Forward Observation
Review Lesson
Military or office address
(RUC number, if available)

Submit your review lesson on the answer sheet and/or forms provided. Complete all blocks and follow the directions on the answer sheet for mailing. Otherwise, your answer sheet may be delayed or lost. If you have to interrupt your studies for any reason and find that you cannot complete your course in one year, you may request a single six month extension by contacting your training NCO, at least one month prior to your course completion deadline date. If you are not attached to a Marine Corps unit you may make this request by letter. Your commanding officer is notified monthly of your status through the monthly Unit Activity Report. In the event of difficulty, contact your training NCO or MCI immediately.

3. MAIL-TIME DELAY

Presented below are the mail-time delays that you may experience between the mailing of your review lesson and its return to you.

	TURNAROUND MAIL TIME	MCI PROCESSING TIME	TOTAL NUMBER DAYS
EAST COAST	16	5	21
WEST COAST	16	5	21
FPO NEW YORK	18	5	23
FPO SAN FRANCISCO	22	5	27

You may also experience a short delay in receiving your final examination due to administrative screening required at MCI.

4. GRADING SYSTEM

LESSONS			EXAMS	
GRADE	PERCENT	MEANING	GRADE	PERCENT
A	94-100	EXCELLENT	A	94-100
B	86-93	ABOVE AVERAGE	B	86-93
C	78-85	AVERAGE	C	78-85
D	70-77	BELOW AVERAGE	D	65-77
NL	BELOW 70	FAILING	F	BELOW 65

You will receive a percentage grade for your review lesson and for the final examination. A review lesson which receives a score below 70 is given a grade of NL (no lesson). It must be resubmitted and PASSED before you will receive an examination. The grade attained on the final exam is your course grade, unless you fail your first exam. Those who fail their first exam will be sent an alternate exam in which the highest grade possible is 65%. Failure of the alternate will result in failure of the course.

5. FINAL EXAMINATION

ACTIVE DUTY PERSONNEL: When you pass your REVIEW LESSON, your examination will be mailed automatically to your commanding officer. The administration of MCI final examinations must be supervised by a commissioned or warrant officer or a staff NCO.

OTHER PERSONNEL: Your examination may be administered and supervised by your supervisor.

6. COMPLETION CERTIFICATE

The completion certificate will be mailed to your commanding officer and your official records will be updated automatically. For non Marines, your completion certificate is mailed to your supervisor.

7. RESERVE RETIREMENT CREDITS

Reserve retirement credits are awarded to inactive duty personnel only. Credits awarded for each course are listed in the "Course Introduction." Credits are only awarded upon successful completion of the course. Reserve retirement credits are not awarded for MCI study performed during drill periods if credits are also awarded for drill attendance.

8. DISENROLLMENT

Only your commanding officer can request your disenrollment from an MCI course. However, an automatic disenrollment occurs if the course is not completed (including the final exam) by the time you reach the CCD (course completion deadline) or the ACCD (adjusted course completion deadline) date. This action will adversely affect the unit's completion rate.

9. ASSISTANCE

Consult your training NCO if you have questions concerning course content. Should he/she be unable to assist you, MCI is ready to help you whenever you need it. Please use the Student Course Content Assistance Request Form (ISD-1) attached to the end of your course booklet or call one of the AUTOVON telephone numbers listed below for the appropriate course writer section.

PERSONNEL/ADMINISTRATION	288-3259
COMMUNICATIONS/ELECTRONICS/AVIATION	
NBC/INTELLIGENCE	288-3604
INFANTRY	288-3611
ENGINEER/MOTOR TRANSPORT	288-2275
SUPPLY/FOOD SERVICES/FISCAL	288-2285
TANKS/ARTILLERY/INFANTRY WEAPONS REPAIR	
LOGISTICS/EMBARKATION/MAINTENANCE MANAGEMENT/	
ASSAULT AMPHIBIAN VEHICLES	288-229[illegible]

For administrative problems use the UAR or call the MCI HOTLINE: 288-4175.

For commercial phone lines, use area code 202 and prefix 433 instead of 288.

CRANE & EXCAVATOR OPERATOR

COURSE INTRODUCTION

CRANE and EXCAVATOR OPERATOR is designed to enable the crane and excavator operator to perform his duties more proficiently by providing him with the study material covering the capabilities of Marine Corps crane and excavator attachments, operating techniques, rigging of wire rope, and operator's preventive maintenance.

ADMINISTRATIVE INFORMATION

ORDER OF STUDIES

Study Unit Number	Study Hours	Subject Material
1	2	Cranes & Excavator
2	3	Attachments & Rope Wire
3	2	Safety
4	2	Operator Maintenance
	2	REVIEW LESSON
	2	FINAL EXAMINATION
	13	

RESERVE RETIREMENT CREDITS:
CREDITS: 4

EXAMINATION: Supervised final examination without textbook or notes; time limit, 1 hour.

MATERIALS: MCI 13.52a Crane & Excavator operator and answer sheet.

RETURN OF MATERIALS: Students who successfully complete this course are permitted to keep the course materials.

Students disenrolled for inactivity or at the request of their commanding officers will return all course materials.

HOW TO TAKE THIS COURSE

This course contains 4 study units. Each study unit begins with a general objective which is a statement of what you should learn from that study unit. The study units are divided into numbered work units, each presenting one or more specific objectives. Read the objective(s) and then the work unit text. At the end of the work unit text are study questions which you should be able to answer without referring to the text of the work unit. After answering the questions, check your answers against the correct ones listed at the end of the study unit. If you miss any of the questions, you should restudy the text of the work unit until you understand the correct response. When you have mastered one study unit, move on to the next. After you have completed all study units, complete the review lesson and take it to your training officer or NCO for mailing to MCI. MCI will mail the final examination to your commanding officer or NCO when you pass the review lesson.

SOURCE MATERIALS

TM 07847A-15	Crane-Wheel-Mounted MC2500, 30 ton Nov 1977
TM 08307A-14/1	Crane-Wheel-Mounted MC 40 Cruz Dec 1979
TM-07691A-15	Crane-Wheel-Mounted 7 1/2 ton M-15B1WF June 1975
TM-07691B-13	Crane-Wheel-Mounted 7 1/2 ton M-RT-48MC Jan 1980
COMMERCIAL	User's Safety Manual 1975

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MARINE CORPS INSTITUTE

STUDY GUIDE

Welcome to the Marine Corps Institute correspondence training program. By enrolling in this course, you have shown a desire to improve the skills you need for effective job performance, and MCI has provided materials to help you achieve your goal. Now all you need is to develop your own method for using these materials to best advantage.

The following guidelines present a four-part approach to completing your MCI course successfully:

1. Make a "reconnaissance" of your materials;
2. Plan your study time and choose a good study environment;
3. Study thoroughly and systematically;
4. Prepare for the final exam.

I. MAKE A "RECONNAISSANCE" OF YOUR MATERIALS

Begin with a look at the course introduction page. Read the COURSE INTRODUCTION to get the "big picture" of the course. Then read the MATERIALS section near the bottom of the page to find out which text(s) and study aids you should have received with the course. If any of the listed materials are missing, see Information for MCI Students to find out how to get them. If you have everything that is listed, you are ready to "reconnoiter" your MCI course.

Read through the table(s) of contents of your text(s). Note the various subjects covered in the course and the order in which they are taught. Leaf through the text(s) and look at the illustrations. Read a few work unit questions to get an idea of the types that are asked. If MCI provides other study aids, such as a slide rule or a plotting board, familiarize yourself with them. Now, get down to specifics!

II. PLAN YOUR STUDY TIME AND CHOOSE A GOOD STUDY ENVIRONMENT

From looking over the course materials, you should have some idea of how much study you will need to complete this course. But "some idea" is not enough. You need to work up a personal study plan; the following steps should give you some help.

(A) Get a calendar and mark those days of the week when you have time free for study. Two study periods per week, each lasting 1 to 3 hours, are suggested for completing the minimum two study units required each month by MCI. Of course, work and other schedules are not the same for everyone. The important thing is that you schedule a regular time for study on the same days of each week.

(B) Read the course introduction page again. The section marked ORDER OF STUDIES tells you the number of study units in the course and the approximate number of study hours you will need to complete each study unit. Plug these study hours into your schedule. For example, if you set aside two 2-hour study periods each week and the ORDER OF STUDIES estimates 2 study hours for your first study unit, you could easily schedule and complete the first study unit in one study period. On your calendar you would mark "Study Unit 1" on the

appropriate day. Suppose that the second study unit of your course requires 3 study hours. In that case, you would divide the study unit in half and work on each half during a separate study period. You would mark your calendar accordingly. Indicate on your calendar exactly when you plan to work on each study unit for the entire course. Do not forget to schedule one or two study periods to prepare for the final exam.

(C) Stick to your schedule.

Besides planning your study time, you should also choose a study environment that is right for you. Most people need a quiet place for study, like a library or a reading lounge; other people study better where there is background music; still others prefer to study out-of-doors. You must choose your study environment carefully so that it fits your individual needs.

III. STUDY THOROUGHLY AND SYSTEMATICALLY

Armed with a workable schedule and situated in a good study environment you are now ready to attack your course study unit by study unit. To begin, turn to the first page of study unit 1. On this page you will find the study unit objective, a statement of what you should be able to do after completing the study unit.

DO NOT begin by reading the work unit questions and flipping through the text for answers. If you do so, you will prepare to fail, not pass, the final exam. Instead, proceed as follows:

(A) Read the objective for the first work unit and then read the work unit text carefully. Make notes on the ideas you feel are important.

(B) Without referring to the text, answer the questions at the end of the work unit.

(C) Check your answers against the correct ones listed at the end of the study unit.

(D) If you miss any of the questions, restudy the work unit until you understand the correct response.

(E) Go on to the next work unit and repeat steps (A) through (D) until you have completed all the work units in the study unit.

Follow the same procedure for each study unit of the course. If you have problems with the text or work unit questions that you cannot solve on your own, ask your section OIC or NCOIC for help. If he cannot aid you, request assistance from MCI on the Student Course Content Assistance Request included with this course.

When you have finished all the study units, complete the course review lesson. Try to answer each question without the aid of reference materials. However, if you do not know an answer, look it up. When you have finished the lesson, take it to your training officer or NCO for mailing to MCI. MCI will grade it and send you a feedback sheet listing course references for any questions that you miss.

IV. PREPARE FOR THE FINAL EXAM

How do you prepare for the final exam? Follow these four steps:

(A) Review each study unit objective as a summary of what was taught in the course.

(B) Reread all portions of the text that you found particularly difficult.

(C) Review all the work unit questions, paying special attention to those you missed the first time around.

(D) Study the course review lesson, paying particular attention to the questions you missed.

If you follow these simple steps, you should do well on the final. GOOD LUCK!

STUDY UNIT 1

CRANE AND EXCAVATOR OPERATOR

STUDY UNIT OBJECTIVE: UPON SUCCESSFUL COMPLETION OF THIS STUDY UNIT, YOU WILL IDENTIFY THE PRIMARY PURPOSE OF A CRANE, AN EXCAVATOR, AND THE COMPONENTS OF THE THREE CRANES AND EXCAVATOR USED BY THE MARINE CORPS. YOU WILL ALSO IDENTIFY LIFTING, FORDING CAPABILITIES, AND CARRIER MOBILITY OF THE CRANES AND EXCAVATOR.

The crane and excavator are the most versatile, the most difficult to operate, and probably the most dangerous pieces of engineering equipment used in the Marine Corps. For these reasons this course has been written for you, the crane and excavator operator. It is designed to provide you with a basic knowledge of the types, components, capacities, and attachments of the three cranes and excavator commonly used in the Marine Corps today. The course also covers safety, operator maintenance, and wire rope handling. It is not intended to take an operator step by step through start and stop techniques. That knowledge is best gained while actually working with specific equipment. The information provided in this course should give the operator the fundamental knowledge that he should have, prior to actually operating a crane and excavator.

The crane first appeared about 1835 and looked like a crude boom with a shovel attachment, mounted on a railroad flat car. Over the years, cranes gradually acquired a variety of attachments and left the rails to appear on crawler tracks or rubber tires.

Work Unit 1-1. PURPOSE & BASIC COMPONENTS

IDENTIFY THE PRIMARY PURPOSE OF THE CRANE AND EXCAVATOR AND THEIR TWO BASIC COMPONENTS.

Cranes are designed to do many jobs under varied conditions, but their basic purpose is to lift a load and place it in a new location. It is through the operator's knowledge and skill that the most efficient use of cranes, excavator, and their attachments will be made. The operation of the mechanism is threefold: hoist, swing, and travel. The boom (fig 1-1) on any crane or the excavator may be raised or lowered through an arc, pivoting about its point of attachment. The boom hoist device provides tne means of lifting and lowering the boom. The swing mechanism allows the entire turntable or upper revolving frame to be revolved through 360° in either direction. The travel mechanism, through wheels or tracks, gives the crane its mobility. The excavator is similar to the crane in these characteristics.

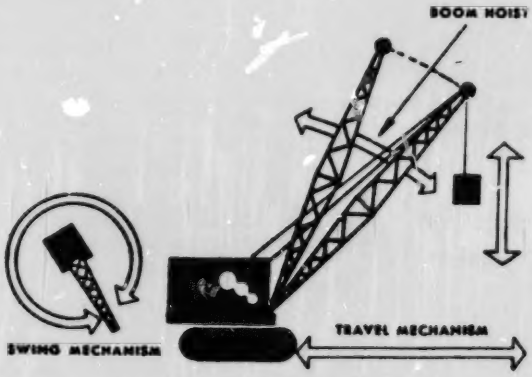


Fig 1-1. Functions of crane-shovel mechanism.

In order for you to understand the cranes and excavator better and to aid you in their use, the basic components of cranes and excavator and the attachments which may be installed on them will be described.

A crane and excavator is made up of two basic components, the mounting (carrier) and the upper revolving superstructure (fig 1-2). The mounting is that portion which supports the upper revolving frame (superstructure) and makes it mobile with either wheels or tracks, such as the Grove, Pettibone, & Drotts (fig 1-2). Also the mounting holds the machinery which powers the cranes and excavator (fig 1-2).

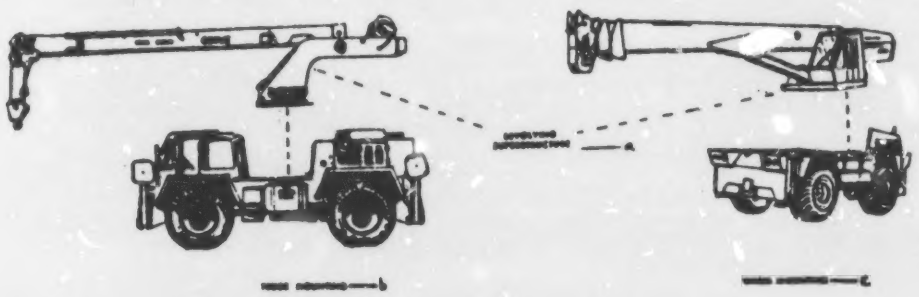


Fig 1-2. Mounting and upper revolving superstructure.

a. Wheel-mounted carrier components (fig 1-3). The wheels are powered by the same engine that is used for the crane and excavator. All three cranes and excavator have a 4-wheel drive capability. The three cranes have 4 wheel steering and the excavator has 2 wheel steering.

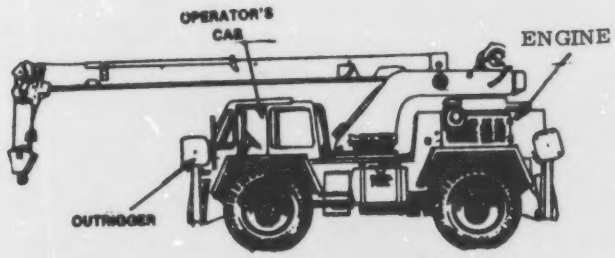
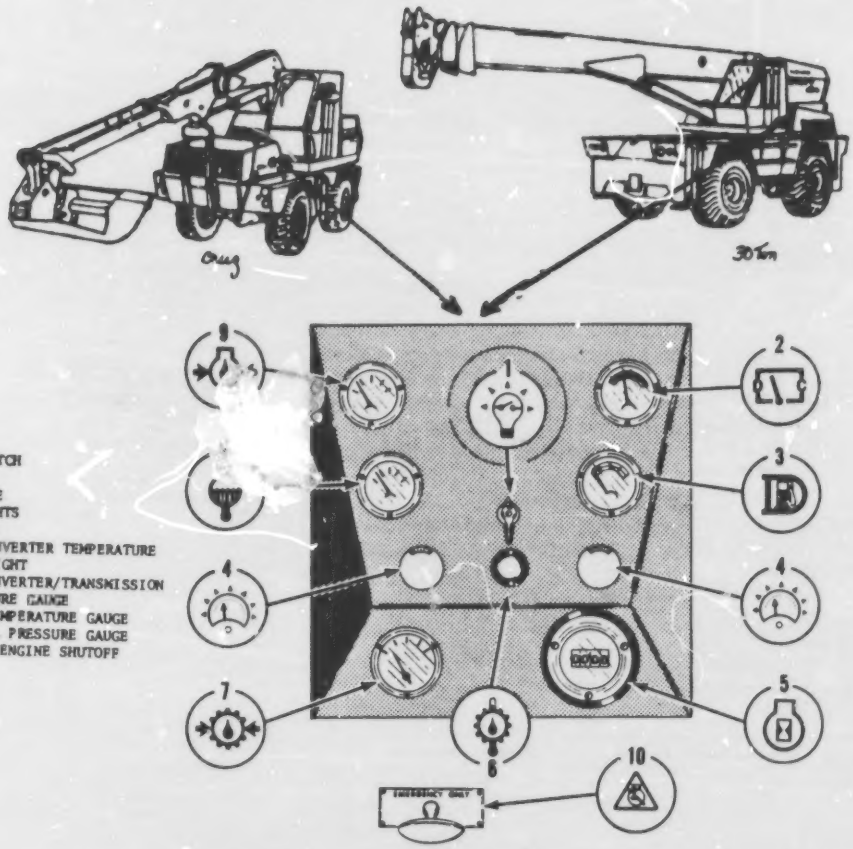


Fig 1-3. Wheel-Mounted Carrier.

All control levers and instruments are stationed in the operator's cab except for the 30-ton Drott and Drott Excavator. The control levers are inside the operator's cab but the instruments and gauges are outside the operator's cab mounted on the engine shroud instrument panel (fig 1-4).



1. LIGHT SWITCH
2. AMMETER
3. FUEL GAUGE
4. PANEL LIGHTS
5. HOURMETER
6. TORQUE CONVERTER TEMPERATURE WARNING LIGHT
7. TORQUE CONVERTER/TRANSMISSION OIL PRESSURE GAUGE
8. COOLANT TEMPERATURE GAUGE
9. ENGINE OIL PRESSURE GAUGE
10. EMERGENCY ENGINE SHUTOFF HANDLE

Fig 1-4. Engine Instrument Panel.

b. Upper revolving frame components. The upper revolving frame (fig 1-5), rests on the travel mechanism mounting. The upper revolving frame consists of the operating mechanism, counterweight, winches and boom. The Drott crane and excavator have the controls in the operator's cab which is also on the superstructure. The boom is attached to the operator's cab, along with the hoist cylinders (fig 1-5, 1-6).

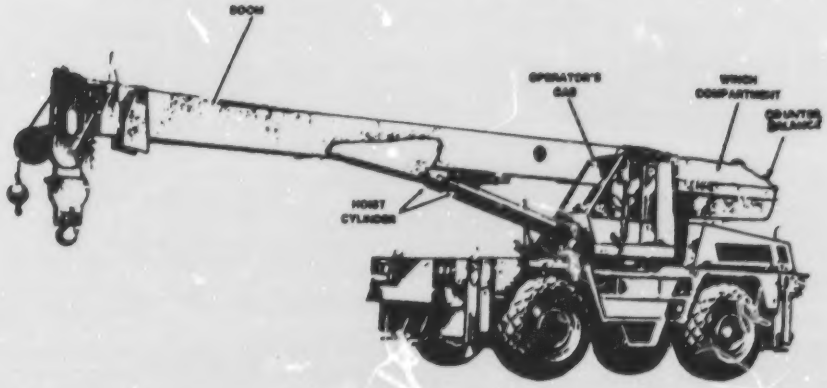


Fig 1-5. Upper Revolving Frame

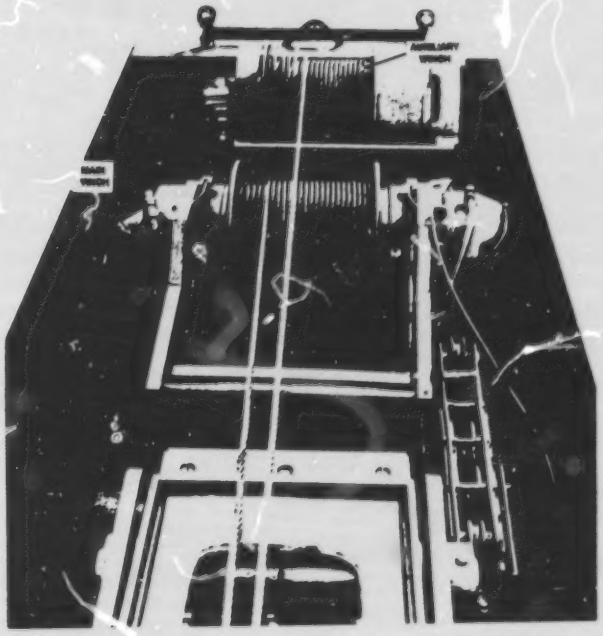


Fig 1-6. Top-Winch Compartment (Drott).

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What is the primary purpose of a crane?

   a. To dig ditches
   b. To build bridges
   c. To lift loads and place them in new locations
   d. To carry loads over long distances

2. What are the two basic components of a crane and excavator?

   a. track-mounted and boom
   b. mounting (carrier) and upper superstructure
   c. wheel-mounted and winch
   d. air-mounted and tires

Unit 1-2. EXCAVATOR AND CRANES USED BY THE MARINE CORPS

WHEN GIVEN AN ILLUSTRATION, MATCH THE THREE CRANES AND EXCAVATOR USED BY THE MARINE CORPS WITH THEIR NOMENCLATURE.

The cranes and excavator discussed here are the MC 2500 30-ton (Drott), MC 40 Cruz (Drott), M-15 BIWF 7 1/2-ton (Pettibone) and the M-RT-48MC 7 1/2-ton (Grove). These are the ones which you will be coming in contact with; therefore, these are the ones which you should become familiar with. While reading about these cranes and excavator, you should keep in mind that engineer units are generally equipped with the full range of attachments for these cranes and excavator. Landing support companies, beach and port operations companies, and maintenance battalions are usually limited to hookblocks and a limited number of clamshell attachments. The cranes and excavator are fully hydraulic.

Pettibone model 15B1WF hydraulic crane (fig 1-7). This crane, which weighs 28,300 lb, has a lifting capacity of 7 1/2 tons. It is a four-wheel drive, four-wheel steer, full revolving, over-fording, diesel-powered, hydraulic crane. The crane is mounted on the center of the vehicle and the hydraulic pump is mounted at the rear. Stablization of the crane is accomplished with outriggers which are located at each corner of the crane.

Fig 1-7. Wheel-mounted 7 1/2-ton hydraulic crane, model Pettibone 15B1WF.

A winch is located at the rear of the three section telescoping boom. This crane is powered by a GM 4-53 diesel engine. The Pettibone crane is generally used in the Reserve Units.

Grove model M-RT-48 MC hydraulic crane (fig 1-8). The crane, wheel-mounted, rough terrain, hydraulic, 7 1/2-ton model RT-48MC (Grove), is a rubber-tired diesel powered, hydraulically operated, material-handling item with a telescoping boom (two sections) capable of lifting 7 1/2-tons. Weight of the crane is 24,760 lbs.

Fig 1-8. Wheel-mounted 7 1/2-ton hydraulic crane, model RT-48MC (Grove).

The nature of modern combat operations has established a requirement for a crane capable of operating over rough terrain and providing means for general cargo handling of loads up to 7 1/2 tons. The subject crane will replace the Anthony 3-ton crane in active ground units and the Pettibone 7 1/2-ton crane now in active Marine Aircraft Wings (MAW's). The Anthony 3-ton crane will remain in the active MAW's to support requirements for an air transportable crane during contingency missions, and the Pettibone 7 1/2-ton crane will be assigned to Marine Corps Reserve units. The Pettibone and Grove cranes are equipped with hook-block attachments.

Wheel-mounted, hydraulic, rough terrain, 30-ton capacity crane, Model MC2500 (fig 1-9). This crane weighs 71,470 lb and has a lifting capacity of 30 tons. It has a boom that is capable of extending from 33 to 80 feet. It is diesel engine-powered and is equipped to operate with a pile-driver, hook-block and a 3/4-cubic yard clamshell bucket. The crane can travel over rough terrain, sandy beaches, and on paved roads at speeds up to 22 MPH. The normal method of steering is by the two front wheels, but the four-wheel carrier is also capable of four-wheel coordinated steering and crab steering.

Fig 1-9. Wheel-mounted 30-ton hydraulic crane, model MC2500.

The 30-ton Drott crane can be found in most Engineering Support units.

The Excavator, hydraulic, multipurpose, wheel-mounted, Model MC40 DR, (fig 1-10).

Fig 1-10. Model MC40 Drott Cruz.

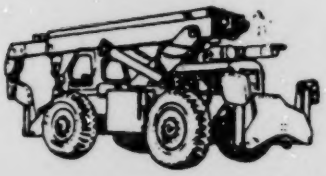
A medium-weight hydraulic excavator is required in Fleet Marine Force (FMF) engineer units to support back-hoe type excavations in development of field fortifications, trenching operations, emplacement of culverts and command bunkers, drainage ditch construction and maintenance, airfield repairs, SAT's installation, water point construction, and construction of bridge launch sites. The Excavator, hydraulic, multipurpose, wheel-mounted, Model MC40 DR, with attachments, will support quarry operations, vehicle loading from material stockpiles, and a variety of other engineer/logistics tasks which deal with rapid excavations.

The Excavator, hydraulic, multipurpose, wheel-mounted, Model MC40 DR, is a diesel-powered, pneumatic-tired, mobile four-wheel drive unit with three interchangeable buckets for excavating, trenching, ditching, sloping, grading, backfilling, riprap work, and loading. This item has mobile capabilities over rough terrain and has a highway speed of 22 miles per hour.

The excavator, hydraulic, multipurpose, wheel-mounted, Model MC40 DR, is fully revolving with an oscillating front axle, four stabilizers or outriggers, universal boom with an extendable tool boom, and a tool boom extension. The Excavator, hydraulic, multipurpose, wheel-mounted, Model MC40 DR, has the capability of lifting a minimum of 10,000 pounds to a 15-foot height at a 15-foot radius.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

Matching: Match each illustration in column 1 (items 1-4) with its appropriate nomenclature in column 2. Select the ONE letter (a, b, c, d, e,) indicating your choice. Place your answers in the spaces provided.

Column 1	Column 2
Illustration	Nomenclature
___ 1. 	a. MC2500 30 TON (DROTT) b. M-RT-48MC 7 1/2 TON (GROVE) c. M-15B1WF 7 1/2 TON (PETTIBONE) d. MC40 Cruz (DROTT) e. M315T (P&H)
___ 2.	
___ 3.	
___ 4.	

Work Unit 1-3. LIFTING CAPABILITIES

IDENTIFY THE THREE FACTORS FOR RATING THE LIFTING CAPACITY OF A CRANE AND EXCAVATOR.

Cranes and excavator are rated by their lifting capacity at a given operating radius, boom angle, and boom length. Operating radius, figure 1-11, is defined as the horizontal distance from the center of the crane's and excavator's turntable to the center of the hook block or attachment suspended over the load: where the load is being lifted from, and where it will be set down.

Some lifts may extend initial working radius; for example, extending the boom to reach the drop point.

When lifting a load near the maximum rated capacity of the crane, (even a small increase in operating radius will affect tipping and structural strength) the boom deflect forward. This increase can be substantial as the boom is fully extended.

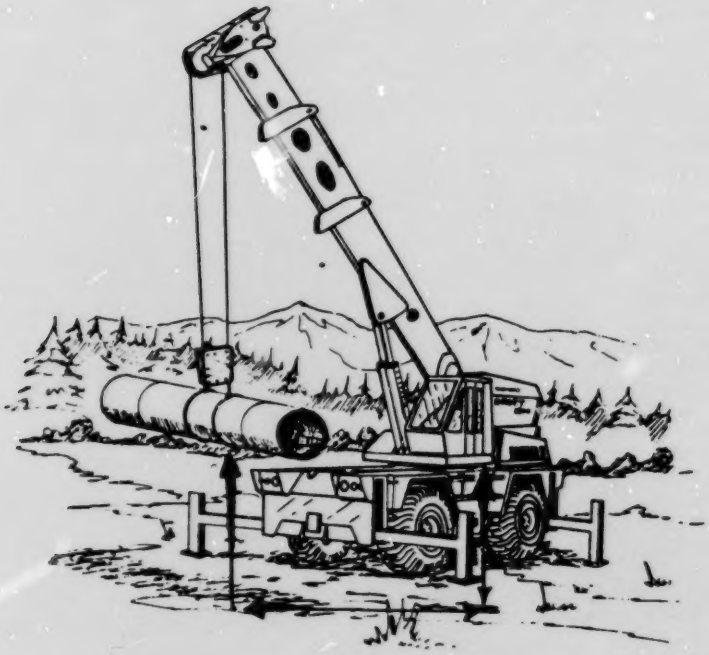


Fig 1-11. Title Operating Radius.

Wheel-mounted cranes are rated at their maximum lifting capacity at a 10-foot operating radius, with outriggers figure 1-12 (which are used to keep the crane level and stable) set, with a 33-foot boom and positioned on firm level footing. The four basic factors to use when determining the lifting capacity are boom length, operating radius, boom angle, and use of outriggers furnished with the crane. Other considerations involved are the amount of counterweights used, weight of the hook block, and the overall maintenance condition of the crane . Keeping these points in mind, always consult the tables furnished with the crane concerning the radius and recommended length of the boom before lifting a certain amount of weight. When referring to the tables, remember the angle of the boom is found on the boom with an indicator as in (fig 1-13).

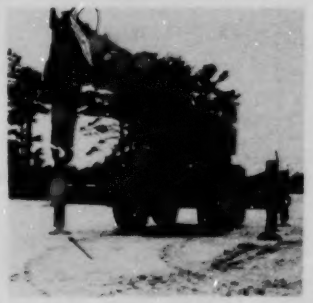


Fig 1-12. Outriggers.

Fig 1-13. Boom angle indicator (Drott 30-ton).

The boom angle range is from minus 5 degrees to 75 degrees. The minimum swing height and the boom angle are indicated by the markings on the boom angle indicator (fig 1-13) which affixed to the left hoist cylinder. The other boom angle indicators are located on the boom itself (referring to the Pettibone and Grove cranes).

Examples of the weight that the cranes discussed here can handle at a given radius or with various lengths of booms are listed in the load charts (found in the TM's and operator's cab) which are provided for each crane operator to follow. See figures 1-14 and 1-15.

15 BIWF 7 1/2-ton Pettibone & RT-48MC 7 1/2-ton Grove Wheel-Mounted cranes, lifting capacity (7 1/2 tons) is applied at a radius measured from the center of rotation of the crane. The working radius is measured from the centerline of turntable in a horizontal plane to a point where the center line of the block will intersect (fig 1-11). Boom length is measured from centerline of boom pivot pin to centerline of boom point sheave.

Loading handling devices, including the hook block, slings must be considered as part of the load and allowances made for their weight as part of the load to be lifted. See Safe Load Data figure 1-14.

Working radius in feet (1)	Boom length in feet (2)	Boom elevation in degrees to obtain working radius	Safe lifting capacity in pounds with outrigger (3)	Safe lifting capacity in pounds without outrigger (3)
10	20	51	15,000	7,000
10	30	64	15,000	7,000
10	40	71	15,000	7,000
15	20	28	11,500	5,000
15	30	52	11,500	5,000
15	40	63	11,500	5,000
20	30	39	6,750	3,250
20	40	54	6,750	3,250
25	30	17	4,500	2,120
25	40	45	4,500	2,120
30	40	33	3,775	1,200
36	40	0	2,300	650

Fig 1-14. Safe load data (both 7 1/2 ton cranes).

The table above is based on the crane operating on firm level surface 360° rotation and 85% tipping.

MC 2500 30-ton Wheel-Mounted Crane (lifting capacity is 30 tons). The rated loads shown (fig 1-15) are for machines with 5200 pounds of counterweight on the upper superstructure and do not exceed 85% of tipping.

1. The rated loads are the maximum lifting capacities as determined by boom length and operating radius. The operating radius is the horizontal distance from the axis of rotation before loading to the center of vertical hoist line or tackle with load applied.
2. The rated loads shown are for machines with 5200 pounds of counterweight on the upper and do not exceed 85% of tipping. These ratings are based on freely suspended loads with the crane leveled and standing on a firm, uniform supporting surface. The ratings make no allowances for adverse job conditions, such as: soft or uneven ground, out of level conditions, high winds, side loads, pendulum action, jerking or sudden stopping of loads, traveling with loads, hazardous conditions, experience of personnel, two machine lifts, electric wires, etc. Side pull on boom is hazardous and is not permitted. (Tire ratings are 75% tipping).
3. Rated loads shown in the black areas are based on structural strength and/or strength of material and not on the stability of the machine.
4. The weights of all load handling devices such as hooks, hook blocks, slings, etc., except the hoist rope shall be considered as part of the load.
5. Ratings with outriggers are based on outriggers fully extended and set to a distance of 8'10" from the longitudinal axis of the carrier to the outrigger float pivot connection and tires clear of the ground and free of crane weight.
6. Ratings on tires depend on tire capacity and condition of tires inflated to 65 PSI.
   To travel with loads:
   -- Use full, retracted boom positioned over front of crane.
   -- Lock-out axle oscillation by engaging the over-ride switch. The axle must not be oscillated before switch is put in axle lock position.
   -- Rest load against cargo bumper with side retainer brackets in extended position.
   -- Limit speeds to 3 miles per hour.
7. CLAMSHELL OPERATION
   The maximum clamshell bucket capacity is 3/4 cu. yd.
   The maximum weight of clamshell bucket and contents should not exceed 7000 pounds.
   Clamshell operation is permitted for boom lengths of 33 to 62 feet and operating radii of 15 to 50 feet.
   Remove the load indicator dynamometer from the wire rope.
   Operate clamshell on outriggers and follow all crane operating notes given on this chart.
   The 7000 pound rating does not exceed 75% of tipping, or 70% of the available closing line pull, or the allowable wire rope loading, when operated within the boom lengths and radii given.
8. DIESEL PILE DRIVER OPERATION
   Operate pile driver on outriggers within the limits of the load chart.
   Both lines holding the pile driver and the pile must remain slack during the driving operation to prevent shock loads on the crane.
9. LOAD INDICATOR
   Set indicator "parts of line" to equal the number of lines between the block and boom point.
   Pre-set a maximum load limit, determined from the rating chart for the operating configuration, based on boom length and operating radius.
   Keep all sheaves in the block, boom point, and dynamometer well lubricated.
10. The maximum load for controlled freefall is limited to 1000 pounds.
11. Do not operate at radii beyond where the load rating charts list no capacity, since the crane can overturn without any load on the hook.
12. The power operated, telescoping boom sections are hydraulically sequenced to extend and retract equally for a maximum of 23'6" for each section. These sections must be extended equally at all times. Any load within the limits of the load chart may be telescoped; however, the maximum load is limited by hydraulic pressure, boom angle, and boom lubrication.
13. When the boom length or the operating radius to be used is between those given on the load rating chart, the rated load is then the load at the next longer boom length or operating radius.

Fig 1-15. Safe load data (30 ton MC 2500).

The ratings make no allowances for adverse job conditions, such as: soft or uneven ground, out of level conditions, high winds, side loading pendulum action, jerking or sudden stopping of loads. For other attachments to this crane consult your TM.

MC40 Cruz Excavator, hydraulic, multipurpose, wheel-mounted. It does not have a load chart but caution must be used when operating. It does swing 360° and outriggers are recommended. For other attachments to this Excavator consult your TM.

Remember:

a. Operating radius is the horizontal distance from the center of the crane's turntable to the center of the hook block suspended over the load. See figure 1-16.

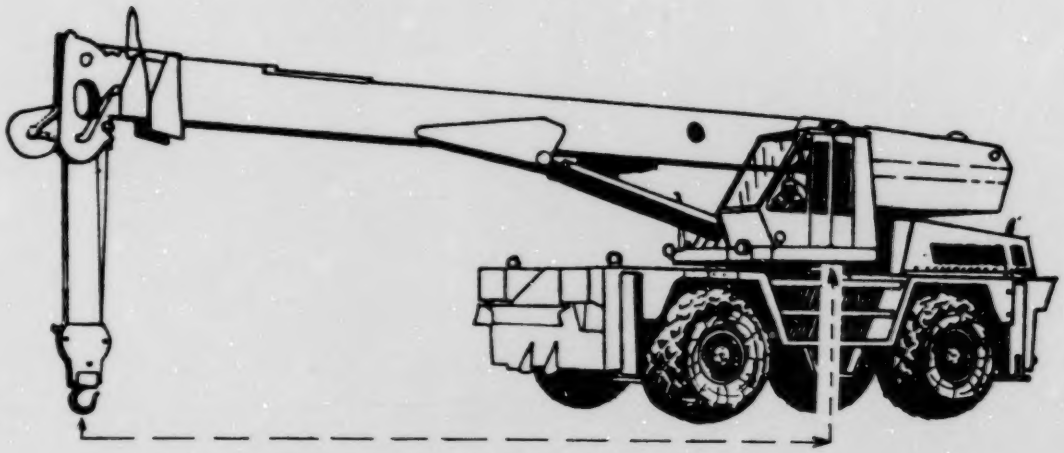


Fig 1-16. Operating radius.

b. Boom length is the distance from the center of the boom hinge pin at the base of the boom, to the end of the last boom section. The Drott 30-ton boom's length is easily read from the cab by looking at the length markings on the side of the number two boom section. See figure 1-17.

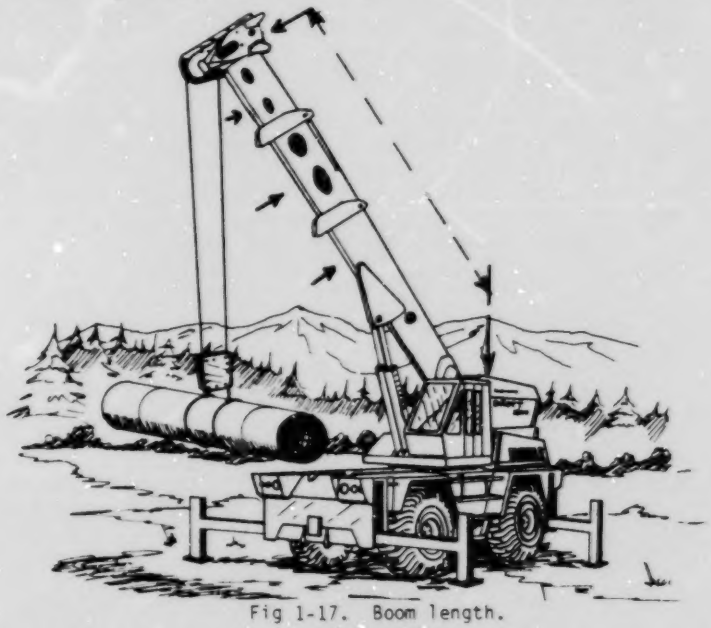


Fig 1-17. Boom length.

c. Boom angle is the angle determined when the boom is raised from a horizontal position. See figure 1-18.

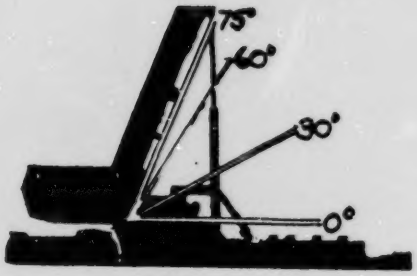


Fig 1-18. Boom angle.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What are the three factors for rating the lifting capacity of a Crane & Excavator?

   a. operating radius, boom angle, boom length.
   b. boom length, boom angle, tipping.
   c. boom length, boom angle, outrigging.

2. What is the horizontal distance from the center of the crane's turntable to the center of the hook block or attachment suspended over the load called?

   a. Boom angle
   b. Boom length
   c. Operating radius

Work Unit 1-4. USAGE OF A LOAD AND WEIGHT CHART

GIVEN AN ILLUSTRATION CHART, MATCH THE MAXIMUM RATED LOADS TO THE OPERATING RADIUS AND BOOM LENGTH.

In determining a safe boom angle and boom length with respect to the weight of the load you must see the load charts to aid you. Every crane is equipped with a set of easy-to-read charts. On most models, the charts are located on the inside cab wall.

Rough terrain cranes have 360- degree lifting capacity. When lift or lower operations are made outside the front working areas, refer only to the load chart marked "Rated Loads for Three Hundred Sixtv Degrees". See figure 1-19.

Fig 1-19. Rated loads for 360°.

Fig 1-20. Rated loads over the front.

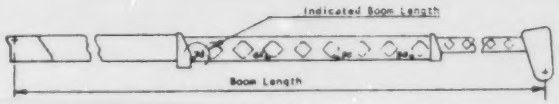
The rough terrain crane operator has two working ranges; if the lift and lower point are within the front working area, defined as the angle from the center of rotation through the center of the front outrigger supports, refer only to the load chart marked "Rated Loads Over the Front". See figure 20.

RATED LIFTING CAPACITIES
33'-80' 3-SECTION FULL POWER TELESCOPING BOOM
MAXIMUM RATED LOADS 360° - OUTRIGGERS DOWN

Operating Radius	BOOM LENGTH 33		38		44		50		56		62		68		74		80	
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]										
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]										
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	15'	21500	34'	21500	45'	21500	52'	21500	57'	21500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35			10'	16500	34'	16500	44'	16500	50'	16500	55'	16500	58'	16500	61'	16500	64'	16500
40					17'	13000	34'	13000	43'	13000	49'	13000	53'	13000	57'	13000	60'	13000
45							20'	10500	34'	10500	42'	10500	48'	10500	52'	10500	56'	10500
50									22'	9000	34'	9000	41'	9000	47'	9000	51'	9000
55											24'	7500	34'	7500	41'	7500	46'	7500
60													25'	6500	34'	6500	40'	6500
65													7'	5500	26'	5500	34'	5500
70															12'	4500	27'	4500
75																	16'	4000
77																	8'	3500

RATED LIFTING CAPACITIES
33'-80' 3-SECTION FULL POWER TELESCOPING BOOM
MAXIMUM RATED LOADS OVER FRONT-OUTRIGGERS DOWN

Operating Radius	BOOM LENGTH 33		38		44		50		56		62		68		74		80	
10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]										
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]										
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
45							[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
50									[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
55											[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
60													[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
65													[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
70															[illegible]	[illegible]	[illegible]	[illegible]
75																	[illegible]	[illegible]
77																	[illegible]	[illegible]



RATED LOADS ON TIRES

OPERATING RADIUS (FEET)	TRAVEL BOOM FRONT	STATIONARY FRONT	STATIONARY 360°
12	33-00	[illegible]	[illegible]
15	27000	[illegible]	15700
20	17000	[illegible]	10100
25	13500	16000	6600
30	10000	11000	6400
[illegible]		8000	3200
40		[illegible]	2200
45		5800	1300
50		4500	
55		3500	
60		3000	

Hard stationary capacities are based on 75% of tipping.

HOIST TACKLE CHART (POUNDS)

NUMBER OF PARTS REEVING	WIRE ROPE 5/8" 6 x 37 IPS IWRC
1	8600
2	17200
3	25800
4	34400
5	43000
6	51600
7	60000

MAXIMUM SINGLE PART LINE CAPACITY FOR 6 x 37 5/8" IPS IWRC WIRE ROPE IS 9600 POUNDS.

Fig 1-21. Rated Load Chart.

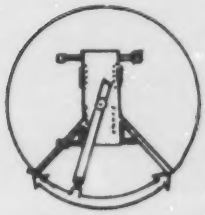
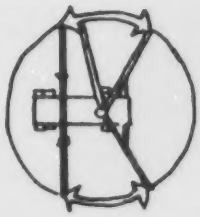
For any lift made off the main boom head, all corresponding load charts are read in the same manner. Boom lengths are shown across the top of the chart. Under each boom length is a complete range of boom angles. The combination of boom length and boom angles equals the opeating radius. See figure 21. radius is shown along the left-hand column. The dark areas of the chart indicate lift capacities based on the structural limits of the crane. The figures in the light areas are based on the stability or tipping factor of the crane.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. Using the diagram on page 1-16 (fig 1-21), Rated Load Chart 360°, determine the maximum rated load for a boom length of 62 feet with a boom angle of 60 degrees?

   a. 34,000
   b. 25,000
   c. 21,000
   d. 19,000

Matching: Match the illustrations in column 1 (items 2-4) with the proper rated load chart for each lift in column 2. Select the ONE letter (a, b, c,) indicating your choice. Place your answers in the spaces provided.

Column 1	Column 2
Illustration	Rated Load
___ 2. 	a. Rated Loads Over Side b. Rated Loads 360 degrees c. Rated Loads Over Front
___ 3.	
___ 4. 	

Work Unit 1-5. FORDING CAPABILITIES

STATE THE FORDING CAPABILITIES OF THE THREE CRANES AND EXCAVATOR.

To ensure success in amphibious operations, landing support and engineer units must assist the landing force in its ship-to-shore movements and facilitate waterborne landing. To get supplies to the beaches, the cranes and excavator must have fording ability. As a normal rule, most cranes and the excavator can be used in water as long as water does not get inside the engine air intake.

Fording precautions. In fording, the 15B1WF, the RT-48MC, MC 2500, and the MC40 Cruz can be moved through water up to the bottom of their superstructures. They all can be subjected to a depth of as much as 60 inches, except for the 15B1WF crane which fords 48".

Always test the depth of the water, allowing for the consistency of the bottom, and never attempt to ford even the narrowest stream if the water is too deep. Be sure that the engine is operating at full efficiency before fording. Shift the transmission into the low-speed range and speed up the engine to minimize the danger of stalling. Always enter the water slowly so the water will not surge into the engine compartment. Maintain a slow, steady speed (3-4mph) while fording. In case complete submersion occurs during fording and you should have to swim out, clear all water from the fuel, hydraulic, and lubrication systems as soon as possible to prevent rusting and dry watersoaked electrical components thoroughly. Start the engine as soon as possible as normal operating heat will dry the crane satisfactorily in a short time.

After-fording, preventive maintenance. Prevention of rust and deterioration of electrical insulation requires continual preventive measures. Frequent inspections are necessary to find worn spots in the insulation. Rust and corrosion on any unit must be corrected immediately. Clean off all rust and paint bare surfaces. Place a light film of lubricant on polished or machined metal surfaces. Remove accumulations of salt or dirt and clean all fittings thoroughly before lubricating.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. Before attempting to ford a stream with a crane or excavator, you should always ensure that the water is no deeper than the

   a. top of the tires
   b. engine air intake
   c. top of the counterweight
   d. bottom of the operator's seat

2. The MC 2500 30-ton Drott crane wheel-mounted can for a depth of how many inches?

   a. 50
   b. 60
   c. 70
   d. 80

Work Unit 1-6. CARRIER MOBILITY

STATE A CARRIER MOBILITY OF ALL THREE CRANES AND EXCAVATOR

Crane mobility capabilities are indeed important to accomplish effectively the assigned mission. When deciding what type of crane to use, you must keep in mind its limitations and capabilities on the beach, off the road, and on the road over long distances.

On the beach. Mobility on the beach is a problem that landing support people encounter. The crane and excavator must have the ability to make ship-to-shore movement and travel across beaches. Making ship-to-shore movement can be quite interesting. It requires a bit of skill for an operator to move the crane off the boat into the surf and onto the beach. It is not unusual for the operator to disappear in the surf, but with discipline he'll ride it out. Consider the difficult job of balancing the crane by lifting the boom while coming down the steep ramp into the surf and then quickly dropping the boom down to keep the crane from tipping over while moving to the beach.

The weight of the wheel-mounted crane and excavator is transmitted to the ground at the point of contact between each tire and the ground. This type of crane has a ground bearing pressure of 75 to 100 psi (fig 1-22) off the road and

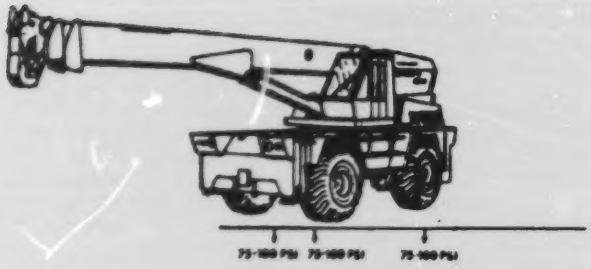


Fig 1-22. Ground bearing pressure.

on the road. The three cranes and excavator can maneuver in rough-terrain as well as on the road.

EXERCISE: Answer the following question and check your response against that listed at the end of this study unit.

1. What is the carrier mobility trait of all three cranes and excavator?

   a. Truck-mounted
   b. Wheel-mounted
   c. Track-mounted
   d. Ski-mounted

SUMMARY REVIEW

In this lesson you learned the primary purpose of the cranes and excavator by lifting loads and placing them in new locations. All the equipment is wheel-mounted. You learned the characteristics of the excavator and the three cranes used by the Marine Corps, and that both are similar. You learned the lifting capabilities and that the excavator and cranes can be forded, and that all these types of equipment are easy to maneuver on or off the road.

Answers to Study Unit #1 Exercises

Work Unit 1-1

1. c.
2. b.

Work Unit 1-2.

1. c.
2. a.
3. b.
4. d.

Work Unit 1-3.

1. a.
2. c.

Work Unit 1-4.

1. c
2. c.
3. b.
4. a.

Work Unit 1-5.

1. b.
2. b.

Work Unit 1-6.

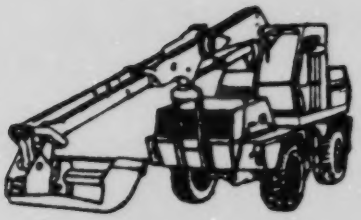
1. b.

STUDY UNIT 2

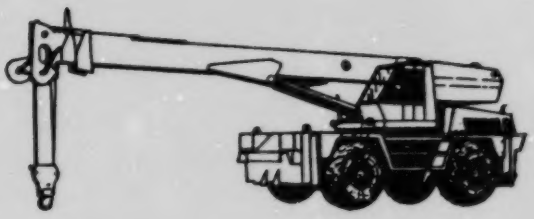
ATTACHMENTS AND WIRE ROPE

STUDY UNIT OBJECTIVE: UPON SUCCESSFUL COMPLETION OF THIS STUDY UNIT, YOU WILL IDENTIFY THE ATTACHMENTS USED ON THE THREE CRANES AND EXCAVATOR, INCLUDING THEIR PURPOSES. YOU WILL ALSO IDENTIFY THE CHARACTERISTICS OF WIRE ROPE, THEIR SEIZING AND CUTTING, AND THE CARE OF WIRE ROPE.

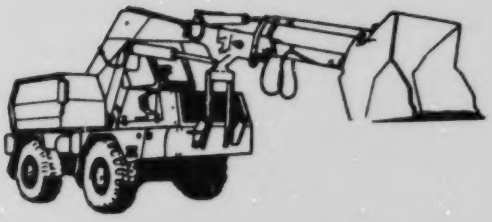
Crane attachments are designed to lift loads and make construction operations possible under various conditions. The six basic attachments (fig 2-1) to be discussed here are the hook block, clamshell, excavator bucket, ditch cleanout bucket w/wrist-o-twist, multipurpose bucket and pile driver. For an operator to make the most efficient use of these attachments, he must know their capabilities and limitations. This study unit discusses these capabilities and limitations. It also covers the characteristics and handling of wire rope.



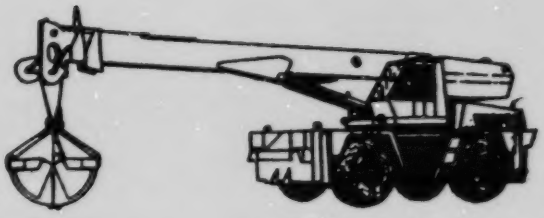
DITCH CLEANOUT BUCKET/
WRIST-O-TWIST



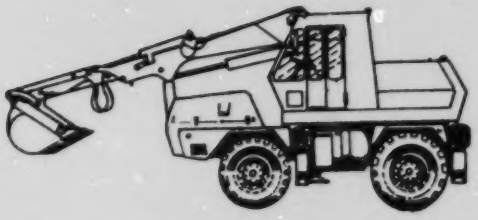
HOOK BLOCK



MULTIPURPOSE BUCKET (4in-1)



CLAMSHELL



EXCAVATOR BUCKET (BACK HOE)

PILE DRIVER

Fig 2-1. Crane and excavator attachments.

Section 1. ATTACHMENTS

Work Unit 2-1. HOOK BLOCK

GIVEN ILLUSTRATIONS OF ATTACHMENTS USED ON THE CRANES AND EXCAVATOR, IDENTIFY THE HOOK BLOCK ATTACHMENT.

IDENTIFY THE PURPOSE OF THE HOOK BLOCK

The hook block (fig 2-2) is the standard crane attachment and is used to perform a wide variety of tasks. Examples are handling steel and other construction material at construction sites and handling cargo at various locations (warehouses, factories, docks, etc.). A crane with a hook block attachment can be used to lift anything weighing up to the capacity rating of the crane.

Fig 2-2. Hook block.

Hook block employment. Before making any lift, you should consult the tables furnished with the crane concerning the handling of specific weight of materials. Remember that you must always include the weight of the hook block when determining the overall weight being lifted. To ensure that the hook block used has the capability to handle the load, you must determine the approximate safe working capacity (SWC) of the hook block. Use the following rule of thumb: SWC in tons is equal to the square of the diameter of the hook or D^2. The diameter (D) measurement is taken where the inside of the hook starts its bend (fig 2-2). Thus the safe working capacity of a hook with a diameter of 3 inches is as follows: $SWC=D^2=(3)\ (3)=9$ tons.

Regardless of the weight of the load, there is a definite procedure for lifting, swinging, and placing load. The five lifting steps are illustrated in figure 2-3.

Step 1. Position the boom over the load (fig 2-3a).

Step 2. Attach the hook and hoist the load (fig 2-3b).

Step 3. Swing the load slowly and smoothly to the desired position and stop gently (fig 2-3c). You can swing and hoist simultaneously.

Step 4. Spot the load over the desired position (fig 2-3d). This requires accurate control of the hoist and swing movements. It takes practice to locate the load at the exact spot without hunting or overshooting. Remember that you can raise or lower the boom to position the load accurately.

Step 5. Slowly lower the load until the hook can be disengaged (fig 2-3e). Disengage the hook. Position the boom over the next load and follow the same procedure.

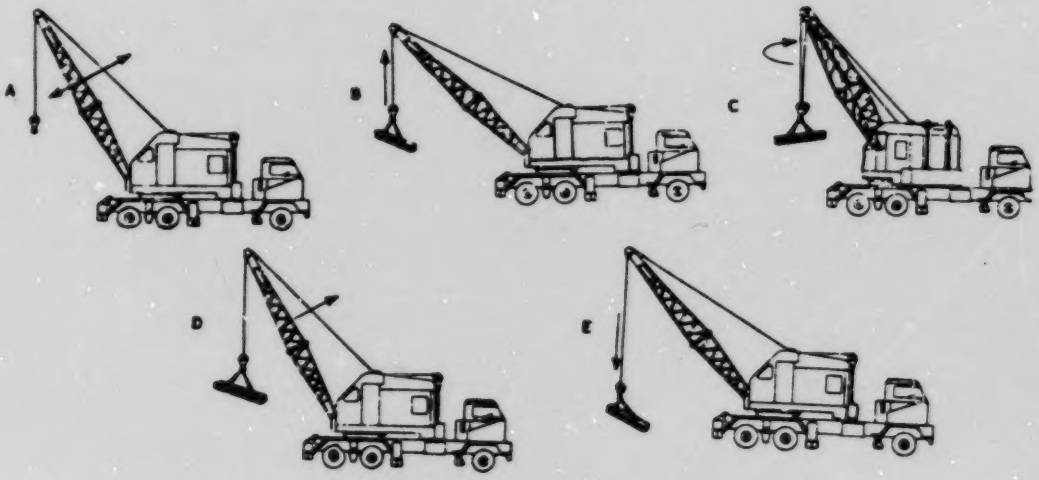


Fig 2-3. Lifting steps.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. From the following illustrations, identify the hook block attachment.

a. b. c. d.

2. What is the purpose of a hook block?

a. To dig ditches
b. To knock piles into the ground
c. To drag waterways
d. To lift anything weighing up to the capacity rating of the crane

3. You are operating a MC2500 Drott crane and are asked to lift a load weighing 12,000 pounds. How should you determine if you can lift this load?

   a. By the length of the wire rope
   b. By the weight of the boom
   c. By the weight of the hook block
   d. By the horsepower of the engine

Work Unit 2-2. CLAMSHELL

GIVEN ILLUSTRATIONS OF ATTACHMENTS USED ON THE CRANES AND EXCAVATOR, IDENTIFY THE CLAMSHELL ATTACHMENT.

IDENTIFY THE PURPOSE OF CLAMSHELL.

The clamshell attachment (fig 2-4) derives its name from the general shape and operation of this type of bucket. In general, the clamshell bucket consists of two halves or shells hinged at the top so that the bucket can be opened, or so that both shells can be drawn together to form a bowl-like bucket. At the beginning of the digging cycle, the bucket is lowered to dig slightly into the material to be lifted. As the closing line is wound up on the drum, the two halves or "clams" of the bucket come together, digging their way into the material and filling the bucket. While the bucket is closing, its weight helps the bucket bite into and penetrate the material being dug. This is the only crowding action available on the clamshell

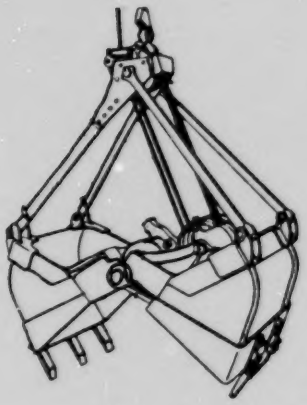


Fig 2-4. clamshell attachment.

The purpose of the clamshell is working at, above and below ground level.

It is capable of digging loose to medium type soils at all three levels. The height that can be reached by the clamshell depends on the length of the boom. The depth that can be reached is limited by the amount of wire rope on the crane drums. The weight that the clamshell can handle will vary, so always refer to the crane's load chart in the TM. Clamshell employment. The jobs on which the clamshell can be used are numerous. It can be used for underwater excavation, for hopper work, and for controlled excavation such as culvert trenches and footings. The clamshell may also be used to dig straight down, as in digging foundations, pier holes, and cellars. Clamshells are also useful for many material-handling jobs such as building stockpiles and loading and unloading railroad cars and haul units.

The following general conditions control the use of clamshells. Material must be relatively soft or loose, up to medium hard. The digging of this material should be in a vertical range: at, above, or below ground level. Jobs requiring accurate dumping or disposal of material are usually chamshell jobs. There are four basic steps in the operation of the clamshell. These are: digging, hoisting the load, spotting and dumping the load, and swinging back to the digging position. The first three operating steps are illustrated in figure 2-5.

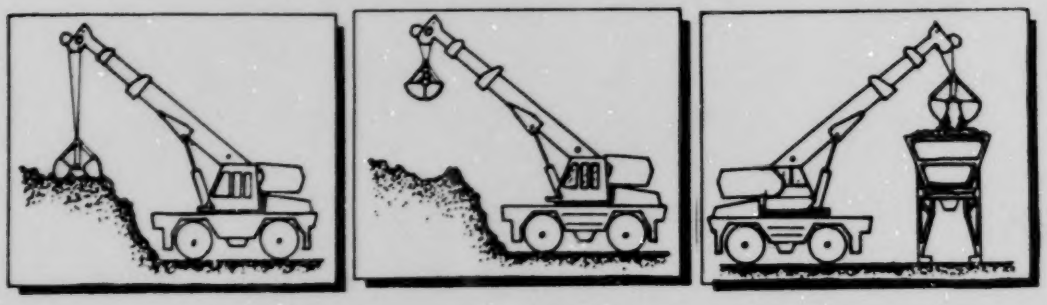


Fig 2-5. Clamshell operating cycle.

Employment of the clamshell in different situations is explained in the following paragraphs.

Loading aggregrate bins or hoppers. When loading aggregrate bins or hoppers, the clamshell should be positioned to minimize the raising and lowing of the boom and the movement of the machine between the stockpile and the hopper. If two clamshells must be used to keep one hopper filled, careful timing by the operators is required to prevent contact between the booms.

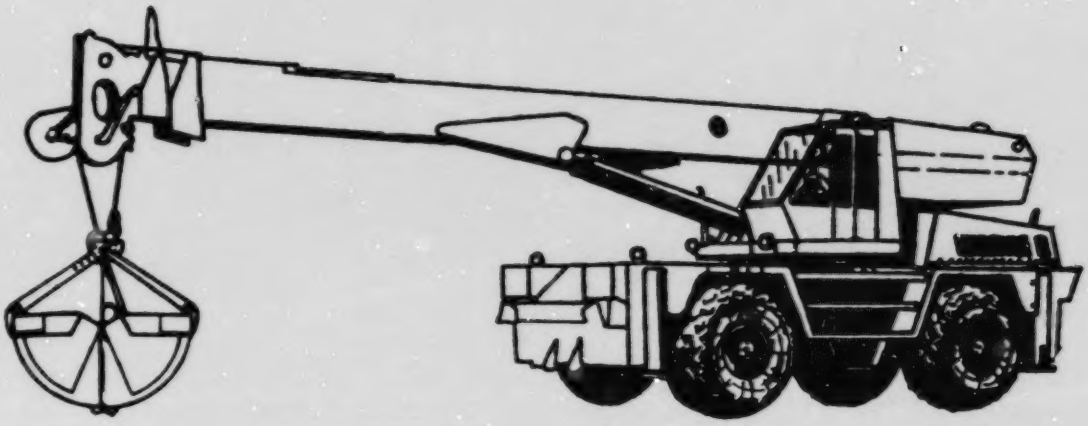


Fig 2-6. MC2500 30-Ton with clamshell attachment.

Shaft or footing excavation. Since the dimensions of this type of excavation may vary, it is difficult to discuss the position of the clamshell for the most efficient operation. There are two important factors to be considered in this operation. These are (1) the amount of wire rope on the crane and (2) the need for the outside edges of the cut to be kept lower than the center to prevent the bucket from drifting toward the center and causing a "V" shaped excavation. In deep excavations, a signalman should guide the operator when the bucket is out of the operator's line of sight. It may also be necessary to use hand taglines to guide the bucket.

Unloading railroad cars. The crane should be positioned parallel to the cars if possible. Starting at one end of the car and digging on the sides enables the work to progress either by moving the crane or by moving the car. Remember that the clamshell teeth may be removed to minimize the possibility of damage to the deck of the car and to permit a more complete unloading of the car. Clamshell equipment consists of the crane boom, a tagline, hoist drum, holding line drum, and a clamshell bucket. The tagline is a small cable under tension which helps keep the bucket from excessive spinning, swaying and twisting. Two drums are used for clamshell work. The closing line is attached to the Auxiliary Winch, which closes the bucket when digging in the material, and will assist in hoisting the bucket to dumping height. The holding line is attached to the Main Winch, and assists in hoisting the bucket to the dumping height. It will also hold the bucket at dumping height while the bucket is being opened for dumping of material.

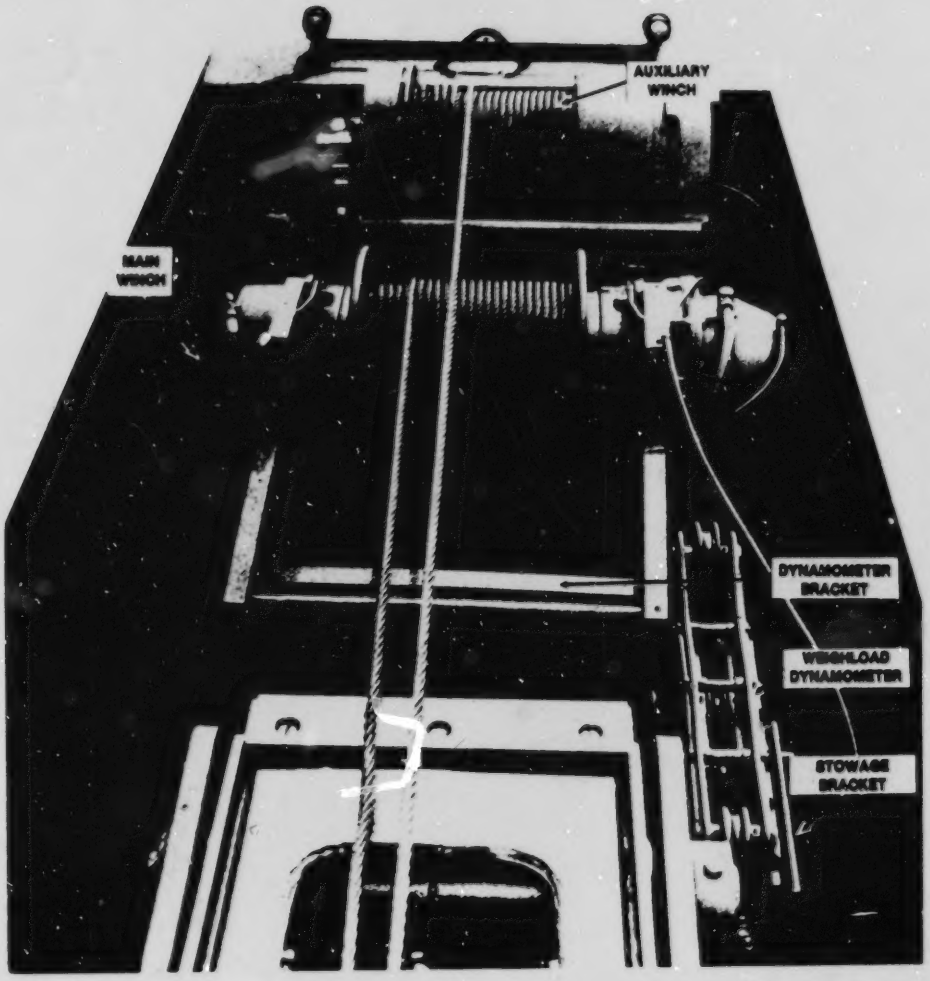


Fig 2-7. Winch Compartment.

A clamshell bucket not to exceed 3/4 cubic yard will be used. Before installing the clamshell, remove the weightload dynamometer, dynamometer bracket, and stow it in the stowage bracket (fig 2-7). Connect the winch cables to the clamshell, then connect the tagline cable to the clamshell.

Some tips for efficient clamshell operation are: If possible, position the crane on level ground to avoid swinging the load "uphill" or "downhill". Position the crane so that the digging operation is at the same radius as the the dumping operation. This prevents excessive wear on the boom mechanism and wasting time by continuously raising and lowering the boom. Use the correct size bucket for the crane. Always refer to your TM !!!

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. From the following illustrations, identify the clamshell attachment.

a.

b.

c.

d.

2. What is the purpose of the clamshell?

   a. To work above or below ground level
   b. To work only on top of the surface
   c. To work above or on ground level
   d. All of the above

3. You have been assigned the task of unloading gravel from railroad cars. Which crane attachment would be best suited for the job?

   a. Pile driver
   b. Clamshell
   c. Excavator bucket
   d. Multipurpose bucket

Work Unit 2-3. PILE DRIVER

GIVEN ILLUSTRATIONS OF ATTACHMENTS USED ON THE CRANES AND EXCAVATOR, IDENTIFY THE PILE DRIVER ATTACHMENT.

IDENTIFY THE PURPOSE OF THE PILE DRIVER.

The pile driver attachment (DA-15B Diesel Driven Pile Driver, fig 2-8) is used to drive wood, steel, and concrete pilings for foundations, bridge bents, piers, and wharves. Pile driver may be operated by air, steam, diesel, or gravity. The diesel-operated type as shown in figure 2-8 will be discussed in this work unit.

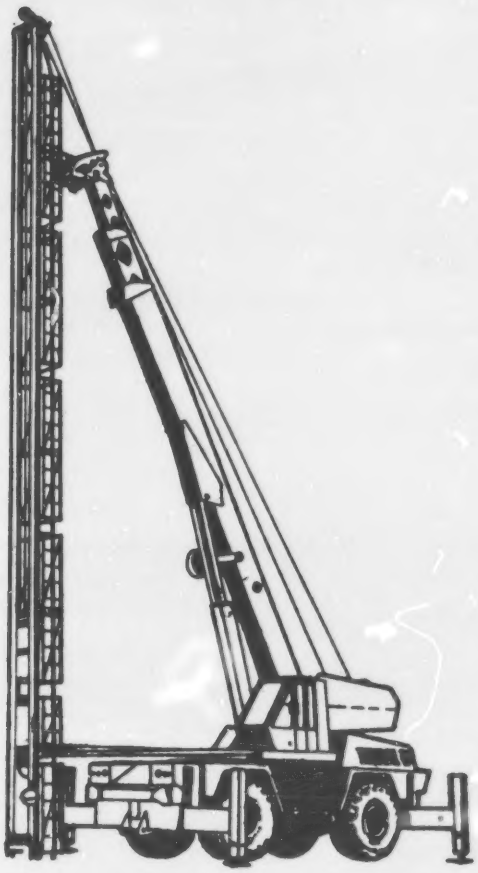


Fig 2-8. DA-15B Diesel Pile Hammer.

There are modifications that must be made to this crane before the crane will accept the pile driver. The rooster sheave must be removed from the boom tip, a roller sheave will be mounted to the top of the boom sheaves. A slide plate will be mounted to the bottom boom sheaves which is attached to the leads. Braces are attached to the revolving superstructure. Be sure to remove the light brackets. The main winch raises and lowers the pile driver, the auxiliary winch raises, lowers, and controls the pile. This attachment takes three men to operate: operator, signalman, and hookup man. Operate the pile driver with the crane on the outriggers within the limits of the load charts. Set the piling with the auxiliary winch, and hold the hammer with the main winch. During operation, both lines must remain slack. Start the pile driver engine, pull the trip lever to activate the driver. Operate the driver until the piling is at desired depth.

NOTE: If the piling stops, do not operate driver after 10 strokes, or pile refusal.

When moving the pile driver, lower frame 6 inches off ground, lower pile hammer to the same position, raise outriggers 6 inches off ground, and then travel with crane. Place in 4-wheel steering and do not exceed a speed of 2 mph.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. From the following illustrations, identify the pile driver attachment.

a. b. c. d.

2. What is the purpose of the pile driver?

a. To drive wood, steel, and concrete pilings
b. To dig ditches
c. To excavate swamps
d. To lift loads

3. What type of fuel does the DA-15B pile driver run on?

a. Gas
b. Nitro
c. Oil
d. Diesel

Work Unit 2-4. EXCAVATOR BUCKET (BACKHOE)

GIVEN ILLUSTRATIONS OF ATTACHMENTS USED ON THE CRANES AND EXCAVATOR, IDENTIFY AN EXCAVATOR BUCKET.

IDENTIFY THE PURPOSE OF THE BACKHOE.

The excavator bucket attachment (fig 2-9) is normally used for digging trenches and for close-limit work. The excavator bucket is capable of digging well below the level of its own wheels/outriggers and also of digging in soft to hard materials. The weight of the boom plus the positive pull on the dipper (backhoe) is used to force the dipper in to the material. The excavator bucket combines the features of the multipurpose bucket and the ditch cleanout bucket attachments. Its dipper is similar to the ditch cleanout bucket, but it digs toward the excavator rather than away from it like the multipurpose bucket. Since the excavator bucket is used primarily for close-limit, below-wheel level work, a check for underground hazards as well as for surface obstacles should be made before beginning to dig. This check is particularly necessary in populated areas where utility wire and pipes are underground. If considerable close-quarter work is expected, small machines or even hand labor may be necessary to complete the job.

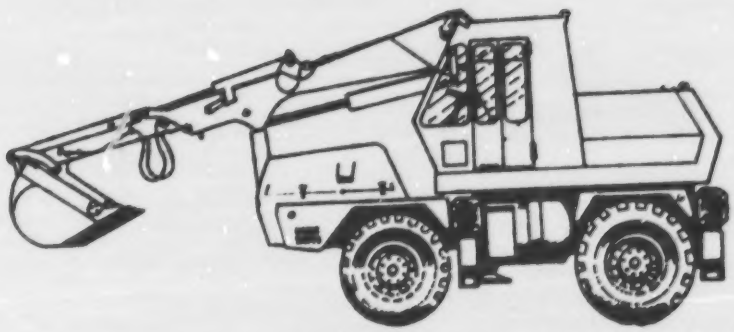
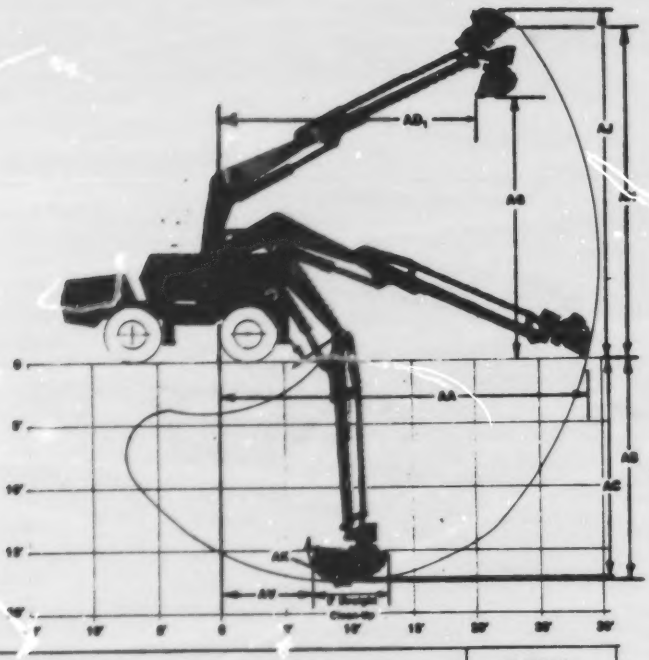


Fig 2-9. Excavator Bucket (backhoe) attachment.

Excavator bucket employment. The efficient positioning of the excavator bucket depends on the type of work to be done and will vary with the job. The excavator bucket is normally associated with two types of excavation, trenches and basements. In some instances it may also be used to load trucks. These three types of operation are explained in the following subparagraphs.

a. Trenching. During trench excavation with the excavator bucket, the excavator should be centered on the trench with the wheels paralleling it. As the digging progresses, the excavator moves backwards away from the end of the excavation. The material is disposed of by loading it in trucks or stockpiling it alongside the trench. Another trenching method involves digging trenches in two cuts. When using this method, you should make the first cut with the boom carried high to excavate the top 35 to 45 percent of the desired trench depth. then move forward about half the length of the excavator and remove the remainder of the material with the boom carried low. This method, although requiring many short moves by the excavator, has the advantages of providing better digging angles for the dipper, better filling of the dipper, and better operator visibility due to close-in dipper action. When using this method, you should be especially alert to the possibility of the excavator's tipping over if the bank should cave in. Figure 2-10 gives the operating specifications of the excavator bucket.



LETTER KEY	DIMENSION DESCRIPTION	BACKHOE BUCKET
AA**	Maximum reach at grade level	30' 1" (9.17m)
AB**	Maximum digging depth	18' 10" (5.74m)
AC	Maximum depth of cut for 8 ft. level bottom (straight clean up)	18' 0" (5.84m)
AD1	Radius of bucket teeth at maximum boom elevation - dipper arm fully extended, bucket swung fully in	19' 7" (5.97m)
AG	Minimum vertical clearance of bucket teeth grade at maximum height	19' 5" (5.84m)
AH*	Cutting edge distance from grade at end of highest dump	27' 3" (8.28m)
AJ*	Maximum height of bucket	27' 5" (8.28m)
AK	Dipper sweep angle	170°
AN	Boom length from boom foot pin to boom point pin	11' 9" (3.58m)
AV	Minimum radius of 8 ft. level bottom at maximum depth	5' (1.32m)

*NOTE: All dimensions are with hoist cylinder pin in upper pin hole and crowd cylinder pin in lower pin hole
**For digging depth w/extension retracted deduct 4' (1.22m).

LIFTING CAPACITIES-lb (Kg)

ABOVE & BELOW GROUND LINE DIMENSION	Distance from Centerline of Rotation							
	15' (4.57m)		15' (4.57m)		25' (7.62m)		25' (7.62m)	
	REAR	SIDE	REAR	SIDE	REAR	SIDE	REAR	SIDE
+15' (4.57m)							4,740 (2 150)	4,085 (1 221)
+10' (3.05m)							5,000 (2 268)	4,180 (1 274)
+5' (1.52m)					6,875 (2 865)	6,135 (1 565)	5,465 (2 474)	4,475* (1 364)
Ground Line			8,550 (3 899)	7,845 (2 329)	6,815 (3 137)	6,090 (1 856)	5,945 (2 651)	4,275* (1 303)
-5' (-1.52m)	14,585 (6 791)	13,980 (4 252)	10,545 (4 808)	8,350 (2 804)	7,585 (3 431)	6,085* (1 844)		
-10' (-3.05m)	15,515 (7 067)	14,585 (4 537)	10,345 (4 647)	8,555 (3 922)	8,545 (3 186)	5,995* (1 827)		

*Indicates a Tipping Condition

Lift capacities include the optional 1,500 lb. (680 Kg) counterweight, 17.5x25 tires, and 725 lb. (329 Kg) ditch cleaning bucket, tool boom extension is in the extended position.
Lift capacities conform to SAE J 1097 testing

Fig 2-10. Excavator bucket specifications.

b. Basement excavations. For basement excavations, the procedures will vary according to the shape of the basement, the restrictions of surrounding properties or buildings, and the requirements for disposing of the soil. When the excavator bucket is used for this type of excavation, the starting point and the digging sequence should be planned so that the excavator conveniently works itself free of the job. Many variations of the two operating plans shown in figure 2-11 are possible. The excavator straddles the outer edge and digs over the end and side of the machine. As the excavation progresses, the excavator moves as the arrows indicate (fig 2-11).

Note: Remember that trenches for service pipes should be dug last. This is done by digging from the basement excavation outward.

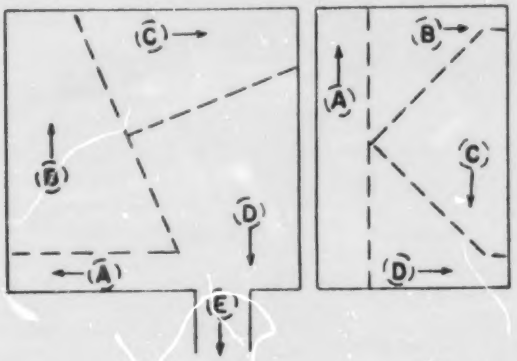


Fig 2-11. Basement excavation plans.

c. Loading trucks. In some instances the excavator bucket is used for loading trucks; however, when loading trucks, the excavator bucket is somewhat sloppy and inefficient and has a slow digging cycle. The sloppiness is due to the material falling from the bucket as it is lifted toward the dumping position. Inefficiency results from the maneuvering necessary to complete a dump within the length of the truck bed. The slow cycle is caused by the necessity of pulling the bucket toward the boom before hoisting it in order to retain the load during the hoist. When loading trucks, you should spot the trucks so they can be loaded from the side. Never swing the load over the cab of the truck. Make sure the operator of the truck is not in the cab.

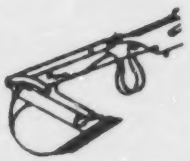
Note: Never swing the superstructure while digging; otherwise undue lateral stress will be placed on the boom.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. From the following illustrations, identify the excavator bucket attachment.

a.

b.



c.

d.

2. What is the purpose of an excavator bucket?

a. To dig pits
b. To excavate quarries
c. To dig trenches
d. To load a grate

3. What check is particularly necessary in populated areas when using the excavator bucket?

   a. Buildings
   b. Trees
   c. Underground wires & pipes
   d. Overhead pipes

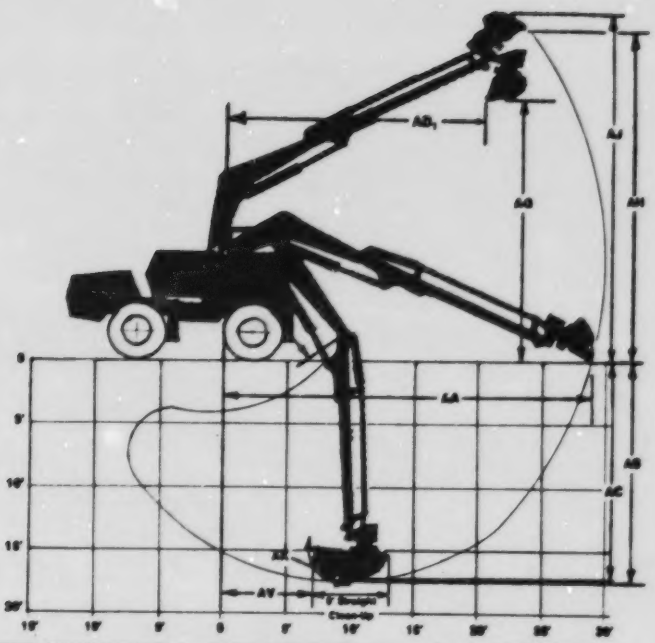
Work Unit 2-5. DITCH CLEANOUT BUCKET W/WRIST-O-TWIST.

GIVEN ILLUSTRATIONS OF ATTACHMENTS USED ON THE CRANES AND EXCAVATOR, IDENTIFY THE DITCH CLEANOUT BUCKET W/WRIST-O-TWIST.

IDENTIFY THE ADVANTAGE OF THE DITCH CLEANOUT BUCKET WITH THE WRIST-O-TWIST.

Fig 2-12. Ditch Cleanout Bucket (B) Wrist-O-Twist (A).

The Ditch Cleanout Bucket w/wrist-o-twist attachment (fig 2-12) is similar to the excavator bucket, but it has a more efficient cleaning action. Both the excavator bucket and ditch cleanout bucket can be equipped with or without the wrist-o-twist attachment. When the ditching bucket is being used always engage the Axle Oscillation Lockouts located on the wheel-mounted frame. It is not necessary to lower the Outriggers. Always start the pass at the far side of the ditch. Successive passes can then be made with each pass moving closer to the near edge of the ditch. On the final cleaning pass the bucket should be only partially full and nearly vertical. This will leave the least amount of dirt to clean up. Have the main boom set for maximum dump height for loading into a truck. Refer to the operators manual (40 Cruz-Air) for further details. The wrist-o-twist aids in different angles of cut and in getting wet or sticky material out of the bucket by revolving the bucket side to side. Figure 2-13 shows the wrist-o-twist and ditch bucket specifications. The wrist-o-twist attachment angles 40^{o} to the left and 40^{o} right.



LETTER KEY	DIMENSION DESCRIPTION	WRIST-O-TWIST & DITCH BUCKET
AA**	Maximum reach at grade level	29'9" (8.83 m)
AB**	Maximum digging depth	17'6" (5.33 m)
AC	Maximum depth of cut for 8 ft. level bottom (straight clean up)	17'1" (5.20 m)
AD1	Radius of bucket teeth at maximum boom elevation - dipper arm fully extended, bucket swung fully in	20'8" (6.30 m)
AG	Minimum vertical clearance of bucket teeth grade at maximum height	20'9" (6.32 m)
AH*	Cutting edge distance from grade at end of highest dump	26'9" (8.15 m)
AJ*	Maximum height of bucket	27'9" (8.46 m)
AK	Dipper sweep angle	170°
AN	Boom length from boom foot pin to boom point pin	11'9" (3.58 m)
AV	Minimum radius of a 8' level bottom at maximum depth	5'0" (1.52 m)

*NOTE: All dimensions are with hoist cylinder pin in upper pin hole and crowd cylinder pin in lower pin hole
**For digging depth w/extension retracted deduct 4' (1.22m).

LIFTING CAPACITIES-lb (Kg)

ABOVE & BELOW GROUND LINE DIMENSION	Distance from Centerline of Rotation 15' (3.86m) REAR	15' (3.86m) SIDE	15' (4.57m) REAR	15' (4.57m) SIDE	20' (6.10m) REAR	20' (6.10m) SIDE	25' (7.62m) REAR	25' (7.62m) SIDE
+15' (4.57m)							4,740 (2 150)	4,096 (1 221)
+10' (3.05m)							5,990 (2 268)	4,186 (1 274)
+5' (1.52m)					6,875 (2 885)	6,136 (1 565)	5,466 (2 474)	4,478* (1 364)
Ground Line			8,536 (3 869)	7,846 (2 329)	6,918 (3 137)	6,936 (1 856)	5,846 (2 651)	4,278* (1 303)
-5' (-1.52m)	14,966 (6 781)	13,966 (4 252)	10,846 (4 566)	9,206 (2 804)	7,586 (3 431)	6,966* (1 844)		
-10' (-3.05m)	16,816 (7 083)	14,866 (4 537)	10,346 (4 647)	9,866 (2 982)	6,846 (3 180)	5,866* (1 927)		

*Indicates a Tipping Condition

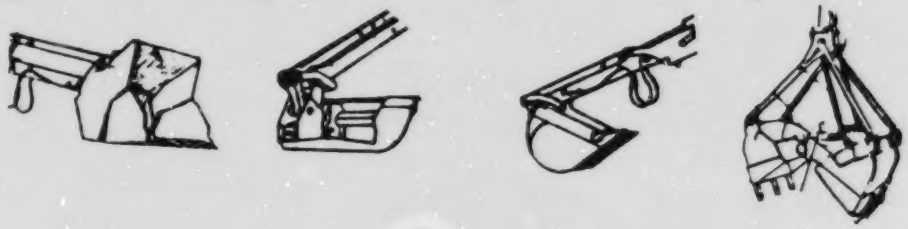
Lift capacities include the optional 1,500 lb. (680 Kg) counterweight, 17.5x25 tires, and 725 lb. (329 Kg) ditch cleaning bucket, tool boom extension is in the extended position.
Lift capacities conform to SAE J 1097 testing

Fig 2-13. Wrist-o-twist and ditch bucket specifications.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. From the following illustrations, identify the ditch cleanout bucket with wrist-o-twist.

a. b. c. d.



2. What is the advantage of the ditch cleanout bucket w/wrist-o-twist?

   a. It has a more efficient cleaning action.
   b. It can drive piles.
   c. It can lift objects.
   d. It has dragline capabilities.

3. Looking at figure 2-13, what is the maximum depth of cut for an 8 foot level bottom (straight clean-up)?

   a. 29'0" (8.83m)
   b. 5'0" (1.52m)
   c. 17'1" (5.20m)
   d. 27'9" (8.46m)

Work Unit 2-6. MULTIPURPOSE BUCKET (DROTT 4 in 1)

GIVEN ILLUSTRATIONS OF ATTACHMENTS USED ON THE CRANES AND EXCAVATOR, IDENTIFY THE MULTIPURPOSE BUCKET.

IDENTIFY THE PURPOSE OF THE MULTIPURPOSE BUCKET.

The multipurpose bucket is probably the most often used attachment in the Marine Corps engineer field (see fig 2-14). It is used as a conventional front-end loader, bulldozer, scraper, or clamshell. It consists principally of the clam and blade. The clam is pinned to the front of, and moved against and then away from the blade by hydraulic cylinders anchored to the blade and attached to the top of the clam.

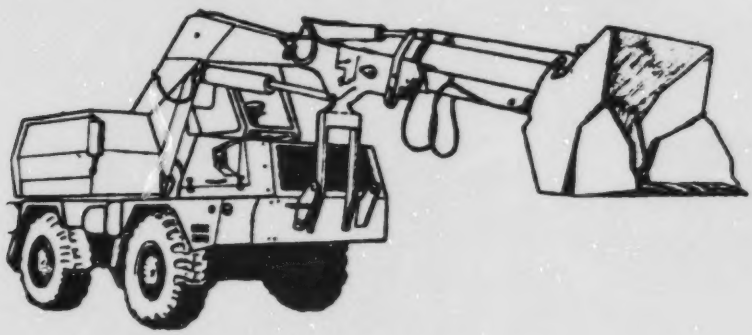


Fig 2-14. Multi-purpose Bucket (1 1/4 cubic yd).

For an illustration of using the front bucket see figure 2-15.

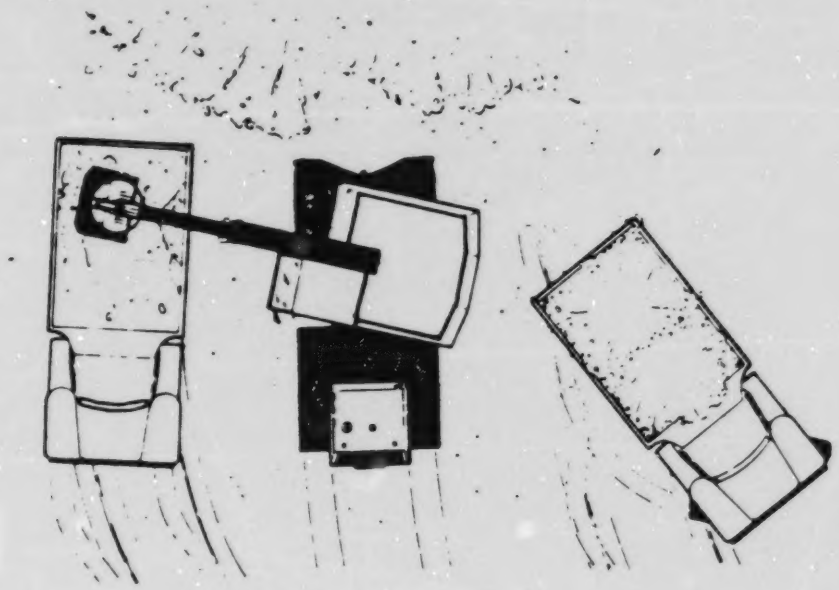


Fig 2-15. Stockpiling with Front Loading Shovel.

When using the scoop-loader, position the machine to use the full 360° rotation of the boom and lower the outriggers. Have the hoist cylinder set for maximum dump height (lower pin hole). One method of working efficiently with the Front-Loading Shovel is called "stockpiling". Figure 2-15 illustrates the use of a Front Loading Shovel.

Handling miscellaneous material. In addition to the uses described above, the Drott 4-in-1 clam-type bucket can be used to backdrag, remove large rocks, remove loose stumps, and to pull posts. Some of these operations are illustrated in fig 2-16. Use caution when performing these operations to prevent excessive shock on the clam or the hydraulic system.

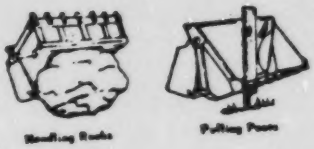


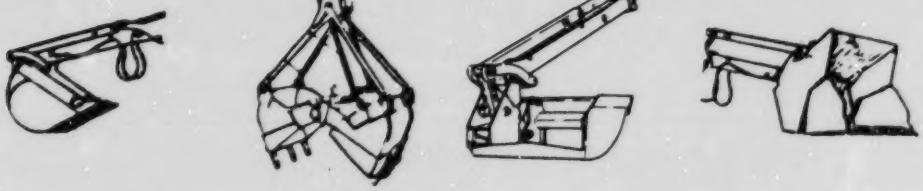
Fig 2-16. Handling rocks and pulling posts with the Drott 4-in-1 attachment.

Note: You do not use the wrist-o-twist attachment with the 4-in-1 bucket.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. From the following illustrations, identify the multipurpose bucket.

a. b. c. d.



2. What is the purpose of the multipurpose bucket?

a. Front-end loader
b. Bulldozer
c. Scraper & clamshell
d. All of the above

Section II. WIRE ROPE

Work Unit 2-7. CHARACTERISTICS OF WIRE ROPE

IDENTIFY THE THREE PARTS OF THE WIRE ROPE.

A very important part of being a good crane operator is knowing the capabilities of wire rope and how they are used with the crane. Wire rope is connected to the crane's winches and attached by a process known as reeving. Since cranes and their attachments may vary, refer to the proper TM for the correct reeving diagram for the equipment you are using. When reeving your crane, you must ensure that the wire rope you use is the correct size, length, and type. If they are incorrect, serious consequences may result. For instance, if your wire rope is too long, the crane's winch will not hold it, and it will run off the edge of the winch. If it is too short, your wire rope may not allow you to do the job, and it may run completely off the drum. Wire ropes should be long enough to maintain one layer of rope on the drum at all times. This layer ensures proper winding for the rest of the wire rope as it is turned onto the drum. Proper wire rope size not only permits using your crane to its maximum rated capacity, but it also makes the sheaves and winches last longer. If the diameter of the wire rope used is smaller than that specified, the rope will wear a groove in the sheave thread. If the diameter of the wire rope used is larger than that specified, the rope will cause excessive wear on the outer edge of the sheave flange.

Construction. Wire rope consists of three parts: wires, strands and core (fig 2-17). In the manufacture of wire rope, a number of wire are wound together to form a strand; then a number of strands are wound together around a core to form the rope. The basic unit of wire rope construction is individual wire. This wire may be made of steel, iron, or other metal. In making the rope, the number of wires in the strands will vary, depending on the purpose for which the rope is intended. Wire rope is designated by the number of strands per rope and the number of wires per strand. Thus, a 1/2 inch 6x19 wire rope (fig 2-18A) will have 6 strands with 19 wires per strand. A 1/2 inch 6x37 wire rope (fig 2-18B) will have 6 strands of 37 much smaller wires per strand. Both wire ropes will have the same outside diameter. A wire rope made of a large number of small wires will be more flexible than one made of large wires. On the other hand, a wire rope of small wires will not be as resistant to external abrasion (wear) as one made of large wires. Consequently, your choice of wire rope will depend on its intended use.

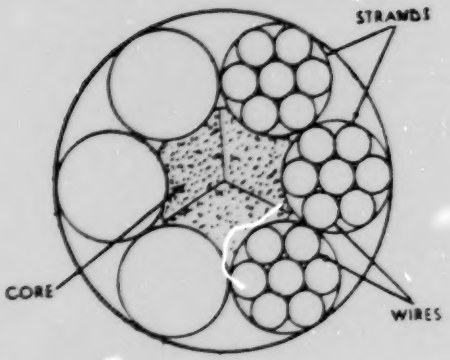


Fig 2-17. Construction of wire rope.

Types. The main types of wire rope used by the Marine Corps consist of 6, 7, 19, 24, or 37 wires in each strand. Normally the wire rope has six strands laid around a fiber or steel core. Two common types of wire rope, 6x19 and 6x37, are illustrated in figure 2-18. The x619 type, having 6 strands with 19 wires in each strand, is commonly used for rough hoisting and skidding work where high abrasion is likely to occur. The 6x37 type, having 6 strands with 37 wires in each strand, is the most flexible of the standard 6-strand wire ropes. Its flexibility makes it particularly suitable for use on equipment with small sheaves and drums.

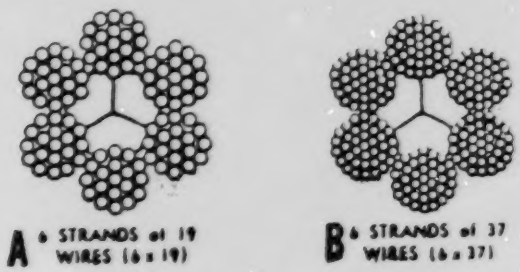


Fig 2-18. Wire rope.

EXERCISE: Answer the following question and check your response against that listed at the end of this study unit.

1. What are the three parts of wire rope?

   a. Rope, strands, core
   b. String, strands, core
   c. Wires, strands, core
   d. Bamboo, strands, core

Work Unit 2-8. SEIZING AND CUTTING WIRE ROPE

IDENTIFY THE PROCEURES FOR SEIZING & CUTTING WIRE ROPE

Seizing. In the manufacture of wire rope, great care is taken in laying each wire in the strand and each strand of the wire rope under uniform tension. Therefore, before cutting wire rope, you must ensure that the ends are properly secured in order to maintain the original balance. Failure to do this may result in some strands carrying a greater portion of the load than others, thus decreasing the working capacity of the wire rope. The process of securing or tying off wire rope before cutting it is called seizing. Before cutting wire rope, place seizing on each side of the point where it is to be cut (fig 2-19). A rule of thumb for determining the seizing width, number of seizings, and the distance between seizings is as follows: One times the diameter for the seizing width, two times the diameter for the distance between seizings, and three times the diameter for the number of seizings. Using this rule of thumb for one-inch diameter wire rope, you would need three seizings, each one inch wide and two inches apart. For permanent seizings, you should insert the seizing wire through the wire rope by using a tool to form an opening. Then lay the seizing wire along the valley between the strands for the width of the seizing and wrap the seizing wire back toward the end of the wire rope. To make a temporary seizing, wrap the seizing wire around the wire rope, taking the required number of turns as shown in step one in figure 2-20. Then twist the ends of the wire counterclockwise by hand so that the twisted portion is near the middle of the seizing as shown in step two. Grasp the ends of the wire with end cutting nippers and twist up the slack as shown in step three. Draw up the seizing as shown in step four. Twist up the slack again by using the nippers as shown in step five. Repeat steps four and five if necessary to tighten seizing. Do not try to tighten seizing by twisting. When the seizing is tight, cut the ends of the seizing wire and pound them down on the wire rope as shown in step six.

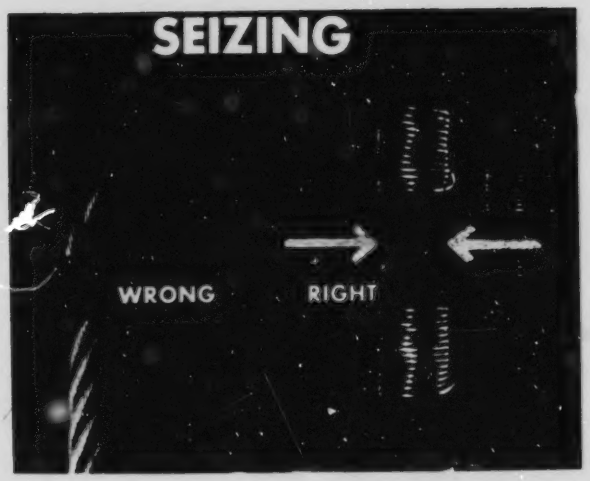


Fig 2-19. Sample seizing before and after cutting.

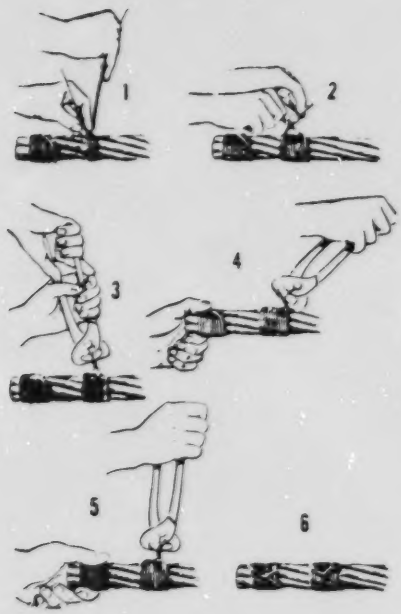


Fig 2-20. Temporary seizing of wire rope.

Cutting. Wire rope can be cut successfully by a number of devices. The two prescribed devices are the hammer-type or the hydraulic-type wire rope cutter and the oxyacetylene torch. For best results using the hammer-type wire rope cutter, place the rope in the bottom of the cutter as illustrated in figure 2-21 so that the blade comes down against the wire rope between the two central seizings. When the blade is in the correct position, strike the top of the cutter sharply several times with a sledge hammer. When using the hydraulic-type wire rope cutter, follow the same procedure as the hammer-type except that instead of a sledge hammer, a hydraulic jack system is used. As you pump the handle, the cutter blade severs the wire rope.

Note: Remember that all wire rope must be seized before it is cut.

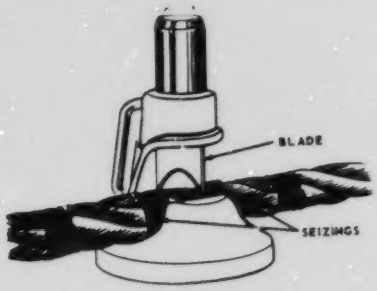


Fig 2-21. Hammer-type wire rope cutter.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What is the procedure to follow when cutting wire rope?

   a. Secure the ends and cut them with a hammer type or rope cutter.
   b. Cut the rope and then secure the ends.
   c. Bend and then cut the rope.
   d. None of the above

2. What is the definition of seizing?

   a. The process of securing or tying off wire rope before cutting
   b. The process of cutting wire rope before tying
   c. The process of fitting it around the right sheave
   d. The process of melting two ends together

3. What device is used to cut wire rope?

   a. Wire rope plier cutter
   b. Wire rope knife
   c. Wire rope hammer-type cutter
   d. Wire rope C4 type cutter

Work Unit 2-9. WIRE ROPE MAINTENANCE

IDENTIFY PREVENTIVE MAINTENANCE MEASURES FOR WIRE ROPE.

Wire rope bending around winch drums and sheaves will wear like any other metal material. For this reason lubrication is just as important to wire rope as it is to any other piece of working machinery. The proper functioning of wire rope depends upon freedom of movement with a minimum of friction between individual wires and strands in relation to each other. Friction caused by lack of lubrication or corrosion or both will seriously shorten the service life of wire rope.

Causes of deterioration. Deterioration of wire rope is normally caused by corrosion or wear. Deterioration caused by corrosion is more dangerous than that caused by wear because it is more difficult to detect by inspection since corrosion normally affects the inside wires. Deterioration caused by wear can be detected by examining the outside wires of the wire rope. these wires will become flat, and their diameter will decrease as the wire rope wears. Any wire rope in which the outside wires are worn to less than 75% of their original diameter should be replaced.

Inspecting wire rope. Wire rope must be inspected by the operator at the time of installation and once a week thereafter when in use. It must be removed from hoisting service when found to be kinked (fig 2-22), birdcaged (fig 2-23), crossed-over (fig 2-24), or when a certain number of wires are broken. The number of broken wires which would require the wire rope to be replaced depends on the wire rope size and how close the broken wires are to each other. You should closely inspect each area of suspected wear. Count the number of broken wires over the distance which is required for one strand to make a complete turn around the rope. If the number of broken wires is equal to or greater than the number shown below, the wire rope should not be used for hoisting.

Broken wires per strand	Wire rope size
3	6 x 7
6	6 x 19
9	6 x 37
8	8 x 19

Note: Once wire rope has been removed from service because of defects, it must be plainly marked or identified as being unfit for further use on cranes or for other load-carrying service.

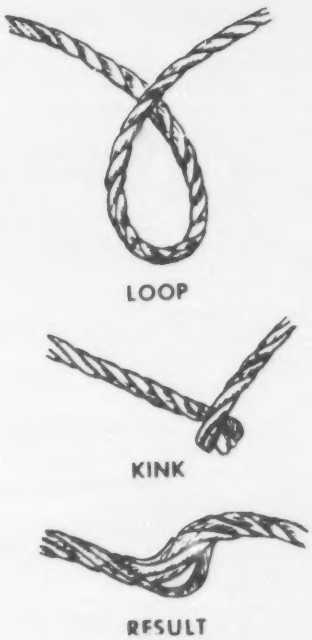


Fig 2-22. Wire rope kinked.

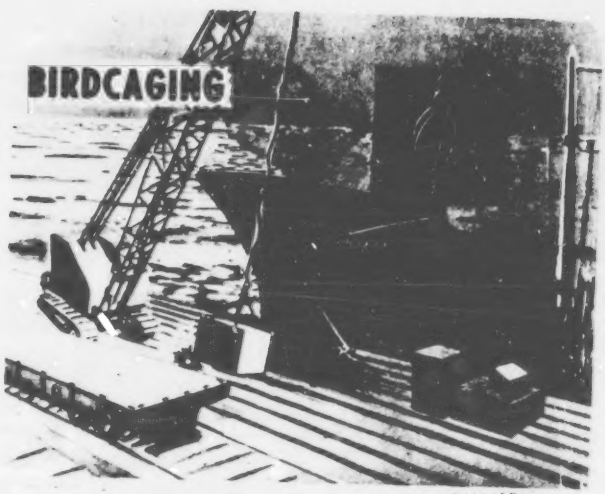


Fig 2-23. Wire rope birdcaging.

Fig 2-24. Wire rope cross-over.

Preventive maintenance

a. Reversing wire rope on sheaves. Wire rope is like a machine in that each time it bends over a sheave or straightens from a slack position, many strands move and slide against each other. The life of the wire rope can be increased by changing the wear patterns. The operator can accomplish this by periodically reversing the wire rope on the crane. This is done by simply removing the wire rope and replacing it end for end.

b. Lubrication. Proper lubrication is necessary to prevent wear as a result of movement. An equally important reason for correct and timely lubrication is to prevent corrosion of wires and deterioration of the fiber core. Correct methods should always be used when applying lubricant to wire rope. Wire rope that has been in service should always be cleaned thoroughly (fig 2-25) before it is lubricated. Use wire brushed, scrapers, or compressed air to clean the wire rope. All possible foreign material and old lubricant should be removed from the valleys between the strands and the spaces between the outer wires. Three methods for applying lubricant to wire rope are pour on, split box, and bath. In the pour-on methods the oil should be hot yet adhesive, and the lubrication should be applied as shown in figure 2-26. Notice that excess oil is removed from the wire rope with a rag. In the second method, you use a split (funnel-shaped) box fitted with burlap at the small end to lubricate and wipe off excess oil in one step (fig 2-27). The bath method shown in figure 2-28 is normally used to apply heavy (thick) lubricants at a high temperature. The heavy lubricant is heated by gas burners or steam to keep it fluid so that it soaks into the wire rope being slowly run through the bath. Each lubrication method has its advantages and disadvantages therefore, the method that is most appropriate should be used.

Fig 2-25. Cleaning wire rope.

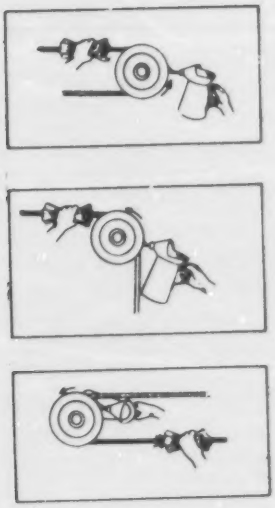


Fig 2-26. Pour-on method.

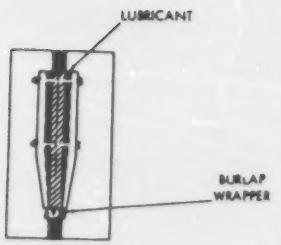


Fig 2-27. Split box method.

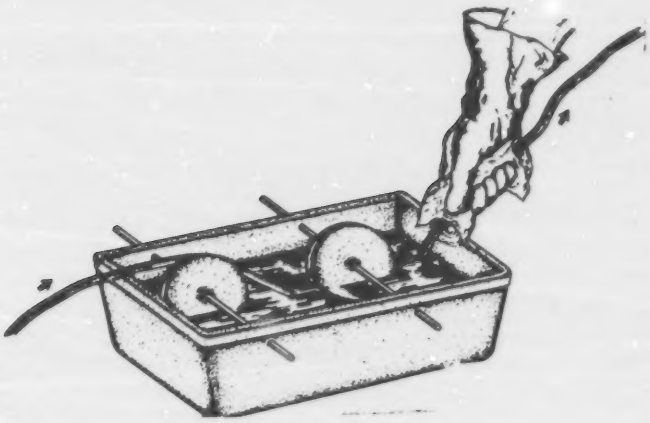


Fig 2-28. Bath method.

Wire Rope Attachments

a. Wedge sockets. There are many different types of attachments which can be fitted to the end of a wire rope to provide a means for connecting the end to a pad eye. The one most frequently used to dead-end wire rope on earthmoving equipment is the wedge socket (fig 2-29). To install a wedge socket, remove the pin and knock out the wedge. Pass the rope up through the socket and lead enough of it back through the socket to allow two inches of the dead end to extend below the socket. Next, replace the wedge and pull the live end of the rope to force the wedge into the socket. Take a strain on the live end to securely seat the wedge. Make sure that the socket is installed on the equipment so that the line end of the wire rope will form a nearly direct line to the clevis pin (fig 2-30). To remove the rope, simply drive the wedge from the socket.

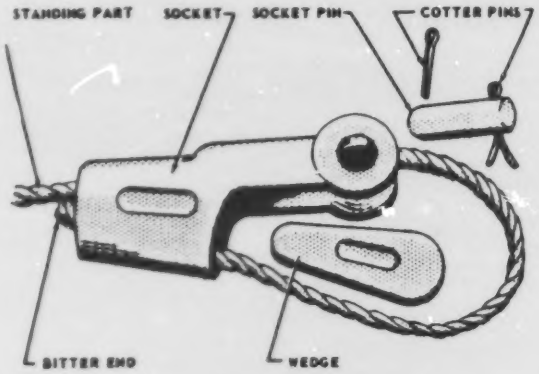


Fig 2-29. Wedge cable socket.

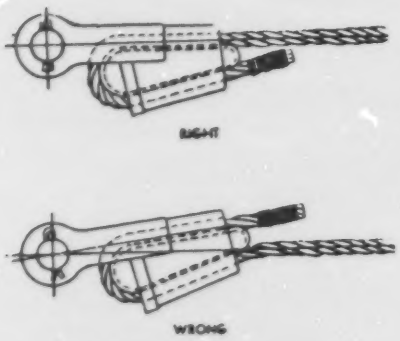


Fig 2-30. Wedge socket and fitting.

b. Wire-rope clips. A common method of making up tow cables, slings, or eyes in the ends of wire rope is by the use of wire-rope clips. Figure 2-31 illustrates the correct method of installing the clips. The number of clips to be installed is equal to 3 times the diameter of the rope, plus 1 (No. clips = 3d + 1). When the calculations result in a fraction, round off to the next largest whole number. The clips should be spaced about six rope diameters apart for best service. After all clips are initially placed on the wire, tighten the clip farthest from the thimble with a wrench. Place the rope under tension and tighten the remaining clips in order, working towards the thimble.

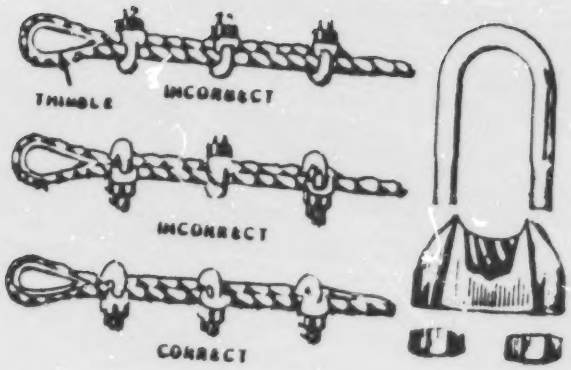
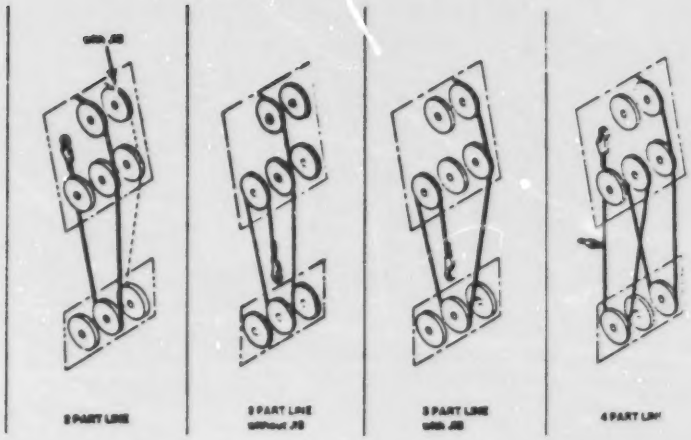


Fig 2-31. Wire-rope clips.

CABLE CHARTS

HOOK BLOCK (Main Hoist)		500 Ft.	5/8"
HOOK BLOCK (Auxiliary Hoist)		350 Ft.	5/8"
CLAMSHELL	Holding Line	200 Ft.	5/8"
	Closing Line	225 Ft.	5/8"
	Tagline Line	75 Ft.	5/16"
PILE DRIVER	(Main Hoist)	150 Ft.	5/8"
	(Auxiliary)	150 Ft.	5/8"



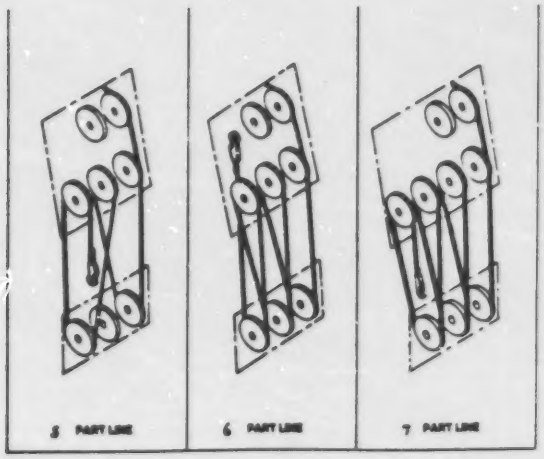


Fig 2-32. Reeving diagrams for the Drott crane.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What two basic steps of preventive maintenance are necessary to care for wire rope?

   a. Lubrication and reverse wire rope on sheave
   b. Brush it and let dry
   c. Paint it and put back on equipment
   d. Cut bent wire and put back on equipment

2. What specific measurement would you use to determine the width, distance, and number of seizings?

   a. The number of strands in a wire rope
   b. The number of wires in a wire rope
   c. The length of the wire rope
   d. The diameter of the wire rope

3. After operating your crane for a long period of time, you notice that the outer edge of the sheave flanges are wearing excessively. What is the cause of this excessive wear?

   a. The wire rope is too long
   b. The wire rope is too short
   c. The diameter of the wire rope is too small
   d. The diameter of the wire rope is too large

4. There are two devices most commonly used for cutting wire rope: the hammer or hydraulic-type wire rope cutter and a(n)_____.

   a. axe
   b. pair of pliers
   c. oxyacetylene torch
   d. pair of tin snips

SUMMARY REVIEW

In this study unit, you learned the uses of the engineer equipment attachments as well as their purpose. You also learned to identify which attachment to use at a job site. You learned the operation of that particular type of attachment as well as the piece of engineer equipment to which it is attached. You learned to identify the characteristics of wire rope, their seizing and cutting, and the care of wire rope.

Answers to Study Unit #2 Exercises.

Work Unit 2-1.

1. c
2. d
3. c

Work Unit 2-2.

1. b
2. a
3. b

Work Unit 2-3.

1. d
2. a
3. d

Work Unit 2-4.

1. b
2. c
3. c

Work Unit 2-5.

1. b
2. a
3. c

Work Unit 2-6.

1. d
2. d

Work Unit 2-7.

1. c

Work Unit 2-8.

1. a
2. a
3. c

Work Unit 2-9.

1. a
2. d
3. d
4. c

STUDY UNIT 3

SAFETY

STUDY UNIT OBJECTIVE: UPON SUCCESSFUL COMPLETION OF THIS STUDY UNIT, YOU WILL IDENTIFY THE SAFETY FACTORS IN LIFTING LOADS AND IN WORKING AREAS USING CRANES AND THE EXCAVATOR. IN ADDITION, YOU WILL ALSO IDENTIFY HAND SIGNALS USED IN CRANE AND EXCAVATOR OPERATION.

Always play it safe! Statistics on accidents show that the fully-hydraulic crane and excavator are among the most dangerous pieces of equipment used in the Marine Corps as well as in private industry. Over one-third of all crane and excavator accidents result in fractured or amputated limbs. Also, over one-third of those injured are crane and excavator operators while only one-quarter are hook-up men or signalmen. This means that the people who sustain the majority of the injuries inflicted by cranes and excavators are the very ones who can do the most to prevent them. Crane and excavator accidents are preventable simply because they are caused by situations, conditions, or actions which are under the control of the operator.

Crane work is performed by two men; the operator and a signalman. The excavator work is conducted by one man, but can use two men depending upon the job. The operator and signalman assume and transfer back and forth to each other the control of lifts, movements, and other activities. It is therefore virtually important that these control responsibilities be clearly defined. The procedures for assuming and transferring them should be laid out in advance and should be thoroughly understood. Under normal working conditions, the responsibility for giving signals should be assigned to only one person. However, the responsibility for giving an emergency signal lies with anyone in the vicinity who believes such a signal is necessary.

Included in your course wrap is a User's Safety Manual. This booklet is part of your reading assignment and both lesson and exam questions will be asked concerning the material covered in it. These safety points are applicable to all hydraulic cranes and excavators used in the Marine Corps. Familiarize yourself with these safety points and practice them, and you will become a much safer and more efficient crane and excavator operator.

Note: Disregard the hand signals on pages 14 and 15 of User's Safety Manual.

Work Unit 3-1. SAFETY FACTORS AND WORKING AREAS

IDENTIFY WHEN A CRANE MUST BE LOAD TESTED.

IDENTIFY TWO PRECAUTIONS TAKEN WHEN A CRANE IS WORKING NEAR A POWER LINE.

IDENTIFY THREE SAFETY FACTORS TO CONSIDER AS THE CRANE OR EXCAVATOR ARRIVES AT THE JOB SITE.

Every crane and excavator must be inspected and load-tested annually for safe load capacity in accordance with Marine Corps Order 11262.2. The safe load chart should be posted in a conspicuous place in the cab near the operator. The operator must familiarize himself with the safe working load and tipping point of that particular piece of equipment.

The excavator and all cranes regardless of size, are rated by their safe lifting capacity based on the following: boom length, operating radius, type of footing, stability, size of attachment, position of lift, and the overall maintenance conditions of the crane and excavator.

Boom length. The standard length of the boom can be increased by two methods, hydraulically activated in which the crane extends its boom three sections long (fig 3-1). The second method is to add a boom tip or extension called a jib (fig 3-2).

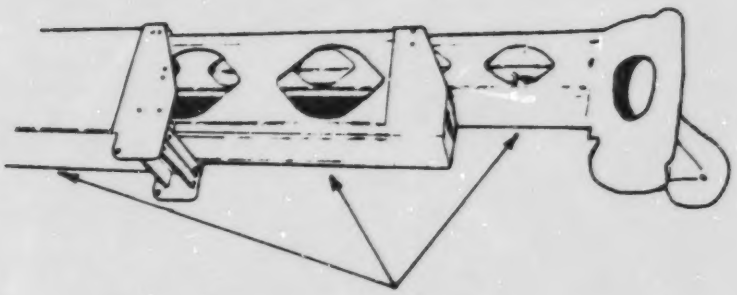


Fig 3-1. Boom extended.

When Using	w/offset	Use Cable(s)
18' (5485 mm) jib	0°	1A
	15°	1A & 1C
	30°	1A & 2C
29' (8840 mm) jib	0°	1A & 1B
	15°	1A, 1B & 1C
	30°	1A, 1B & 2C
40' (12 190 mm) jib	0°	1A & 2B
	15°	1A, 2B & 1 C
	30°	1A, 2B & 2C
	Cable Lengths:	A = 39' 9" (12 115 mm)
		B = 21' 1" (6425 mm)
		C = 2' 8" (8130 mm)

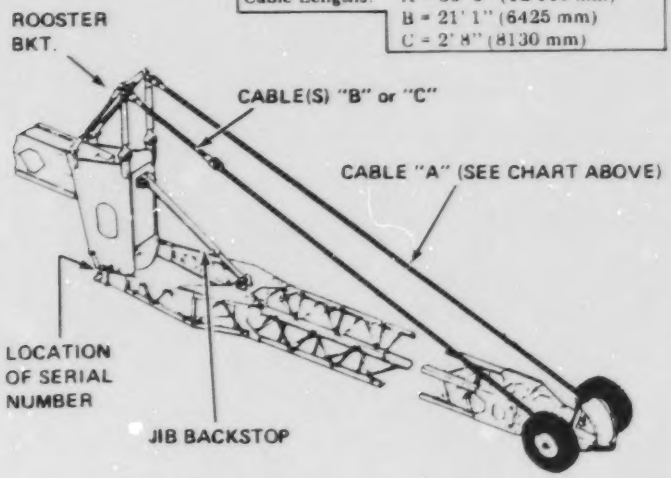


Fig 3-2. Boom jib.

The excavator has a Y-type boom which hydraulic cylinders maneuver up and down. These cylinders are also called tool cylinder and boom crowd cylinder (fig 3-3).

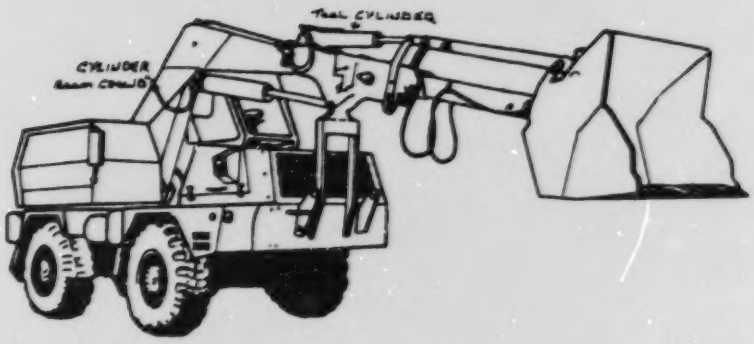


Fig 3-3. Boom cylinders.

The jib may be used as a straight continuation of the boom or may be offset from the boom center line to provide greater horizontal reach. Crane lifting capacities are reduced when boom lengths exceed the normal standard boom length. They are further reduced when the boom jib attachment is used. This is due to the increased movement arm or operating radius.

Operating radius. Radius is defined as the horizontal distance measured from the axis of rotation of the cab to the vertical line extending down from the outside edge of the crane and excavator boom head. A crane and excavator are rated according to lifting capacities at various radii. A crane and excavator are rated on the maximum load it is capable of lifting. See load chart in each crane and excavator for safe lifting located in the cab.

Type of footing. It is extremely important that the crane and excavator be positioned on firm and level material to prevent it from being accidentally tipped over. The footing must be kept firm and level not only to prevent tipping but also to reduce excessive stresses on the machine. If necessary, the site where the crane and excavator are to be positioned should be prepared in advance.

Stability. Cranes and the excavator can be made stable by one of two methods: the proper use of the outriggers, and working on, and/or traveling on stable ground.

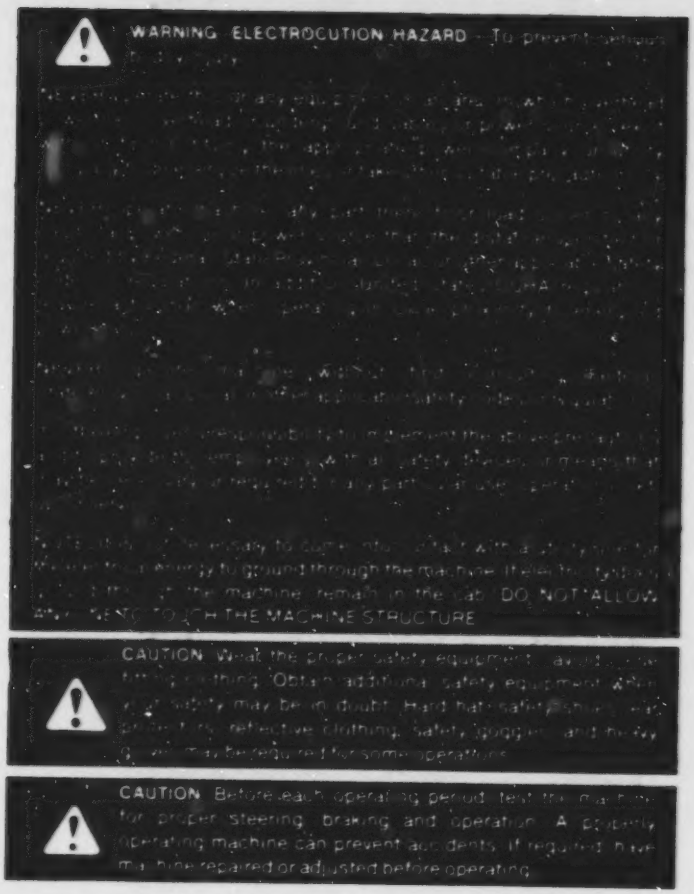
Attachments. The attachment used on a crane or excavator should be the size prescribed by the technical manual for that particular crane or excavator. Although other sizes of attachments can be used, the hook block and sheave on a crane may be damaged through lack of proper rigging and hook capacity. Tables of lifting capacities usually do not include allowances for the weight of the attachment being used; therefore, the attachment weight must be added to the overall weight being lifted.

Position of lift. A crane or excavator can lift its heaviest load when the load is at the specified operating radius and when the boom and the load are directly behind the crane or excavator. A crane cannot lift as heavy a load from either side even if that load is at the specified operating radius. If an attempt is made to pick up the maximum load from the side of the crane, tipping may occur; however, as for the excavator it is better equipped for lifting from the side. Tipping occurs on wheel-mounted cranes and the excavator when one or more wheels leave the supporting surface.

Condition of the crane and excavator. The maximum safe lifting capacity for cranes and excavator usually applies to the equipment that is relatively new. As a crane or excavator is used or becomes older, its condition can deteriorate so that it can no longer perform certain jobs safely. Each of the following items should have adequate checks to ensure that its condition will not limit lifting capacities: the type, size, and condition of the wire rope; the type, size and, condition of the attachment; a visual inspection of the boom and the mechanical condition of the engine.

Note: Here are some safety procedures to follow:

SAFETY PRECAUTIONS



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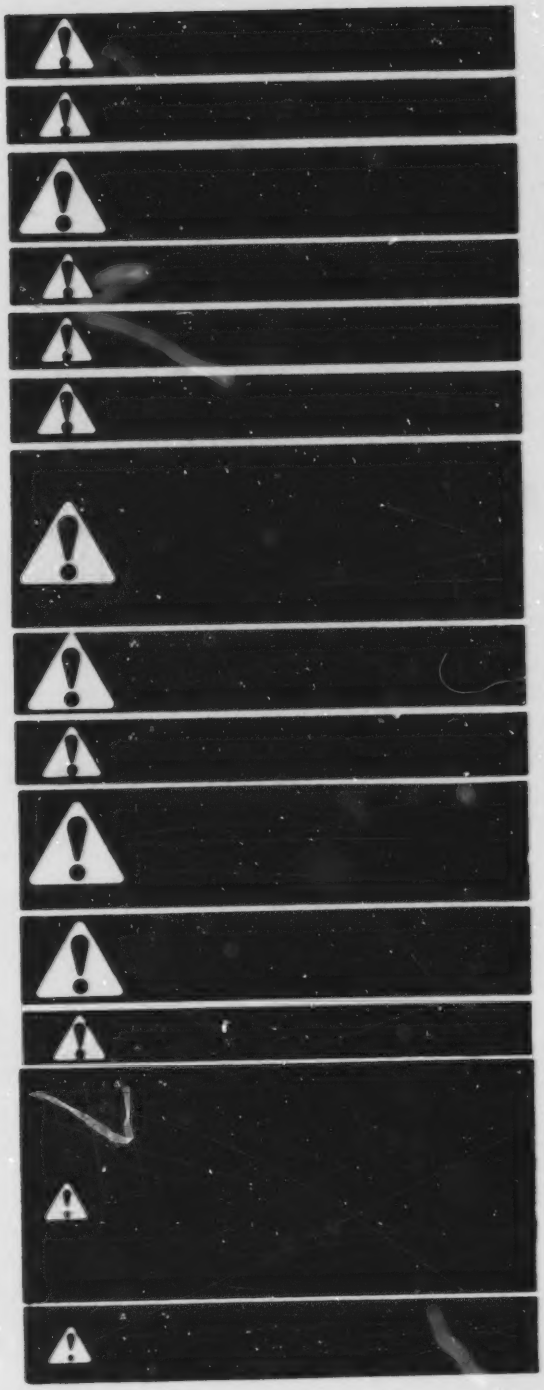

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EXERCISE: Answer the following questions and check your responses against those at the end of this study unit.

1. How often should the crane and excavator be load tested?

   a. Semi-annually
   b. Quarterly
   c. Annually
   d. Weekly

2. What two safety precautions should be taken when a crane is working near power lines?

   a. Use a signal man and disconnect the power.
   b. Ground the crane and issue the operator protective clothing.
   c. Ground the crane and ground the load.
   d. Insulate the equipment and have a corpsman nearby.

3. The job site for a crane or excavator should be graded provide there is enough room in which to manuever the end item and provided there

   a. is adequate boom clearance.
   b. is security.
   c. are no electric power lines.
   d. are no underground utilities.

Work Unit 3-2. HAND SIGNALS

FROM ILLUSTRATIONS AND CHARTS PROVIDED, MATCH THE HAND SIGNALS WITH THE APPROPRIATE WORDS.

It is necessary for the operator and signalman to have a uniform set which must be used on all operations of similar nature. The signals in use should be posted in the operator's position, at signal control points, and at such other points as necessary to inform those concerned. Where manual signals are used, only one person shall be designated to give signals to the operator. This signalman must be located so as to be clearly visible to the operator at all times. Only persons who are dependable and fully qualified by experience with the operation being directed, shall be used as signalmen. A signalman should always be used when the crane and excavator are in operation.

Signals (fig 3-4). The 21 hand signals shown in figure 3-4 are those used by the Marine Corps crane and excavator operators. A good signalman is capable of using any combination of these in order to transfer his message to the operator. The signalman and the operator should drill themselves so that there will be no mistakes in understanding the signals.

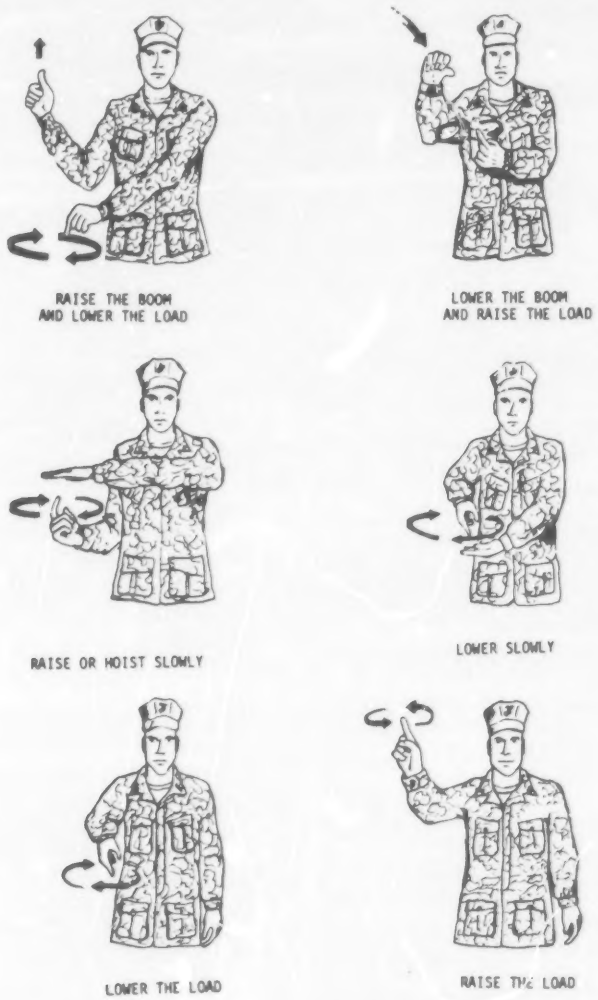

RAISE THE BOOM AND LOWER THE LOAD
LOWER THE BOOM AND RAISE THE LOAD
RAISE OR HOIST SLOWLY
LOWER SLOWLY
LOWER THE LOAD
RAISE THE LOAD

Fig 3-4. Hand signals.

SWING IN DIRECTION FINGER POINTS
STOP
RAISE THE BOOM
LOWER THE BOOM
EMERGENCY STOP
(STOP ALL MOTION AS QUICKLY AS POSSIBLE.)
MANEUVER FORWARD SLOW AND EASY
(WHEN MANEUVERING IN CLOSE QUARTERS OR TO MOVE A FOOT OR TWO AT A TIME.)

Fig 3-4. Hand signals (continued).

LOWER THE BOOM SLOWLY

RAISE THE BOOM SLOWLY

LOWER A LITTLE

RAISE A LITTLE

LOWER THE BOOM
AND HOLD THE LOAD

RAISE THE BOOM AND
HOLD THE LOAD

Fig 3-4. Hand signals (continued).

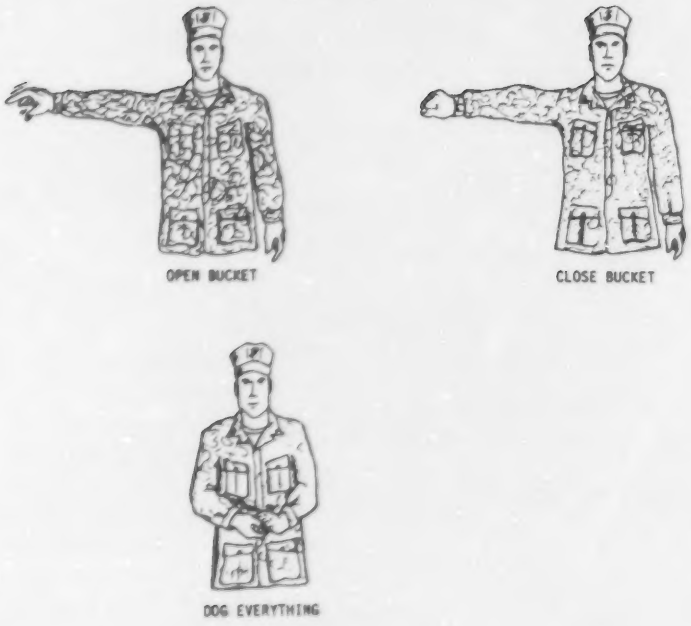


Fig 3-4. Hand signals (continued).

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

Matching: Match each of the four hand signals listed in questions 1 through 4 with their appropriate illustration (a through d). Place your answers in the space provided.

_____ 1. Stop
_____ 2. Open bucket
_____ 3. Raise the load
_____ 4. Swing in direction finger points

a.

b.

c.

d.

SUMMARY REVIEW

In this study unit, you have learned the procedures for safety factors in lifting loads and in working areas using the crane and excavator. In addition, you also learned to illustrate the hand signals for crane and excavator operation.

Answers to Study Unit #3 Exercises

Work Units 3-1.

1. c
2. a
3. a

Work Unit 3-2.

1. b
2. c
3. d
4. a

STUDY UNIT 4

OPERATOR MAINTENANCE

STUDY UNIT OBJECTIVE: UPON SUCCESSFUL COMPLETION OF THIS STUDY UNIT YOU WILL IDENTIFY BEFORE-OPERATION, DURING-OPERATION, AND AFTER-OPERATION CHECKS. IN ADDITION, YOU WILL IDENTIFY TROUBLESHOOTING PROCEDURES, LUBRICATION INSTRUCTION, AND SAFETY PRECAUTIONS TO BE USED WITH THE EXCAVATOR AND CRANES.

Equipment breakdowns cause construction delays, waste man-hours, and cost considerable amounts of money in both parts and labor. You can minimize equipment breakdowns by operating your equipment with good judgment. This includes keeping the engine and the gear cases filled with the right oil, keeping the engine cooling system filled with coolant, keeping the grease points properly lubricated, making minor repairs as they are needed, and keeping your equipment clean. This sounds like a lot of trouble to go to, but it is really not hard to do if you apply yourself. Your knowledge and respect for cranes and the excavator should make it irritating to you to see someone abuse the equipment (fig 4-1).

Fig 4-1. Never abuse your equipment.

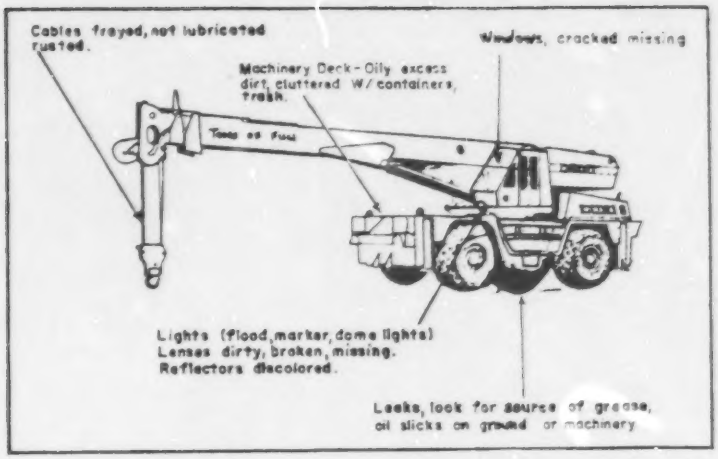
As an operator, you should ensure that your crane and excavator are ready for operation at all times. You should inspect it before-operation, during-operation, and after-operation, so that any defects may be discovered and corrected before they result in serious damage or equipment failure. The necessary preventive maintenance services should be performed before-operation. Minor defects discovered during operation of the unit should be corrected as soon as operation has stopped. If a major problem is noticed during operation, the equipment should be stopped immediately to prevent any damage which might occur to the equipment. After-operation services should be performed by the operator at intervals based on the normal operation of the crane and excavator. Remember that if you, as an operator, find defects or unsatisfactory characteristics beyond your maintenance level, you must report them at the earliest opportunity to your NCOIC.

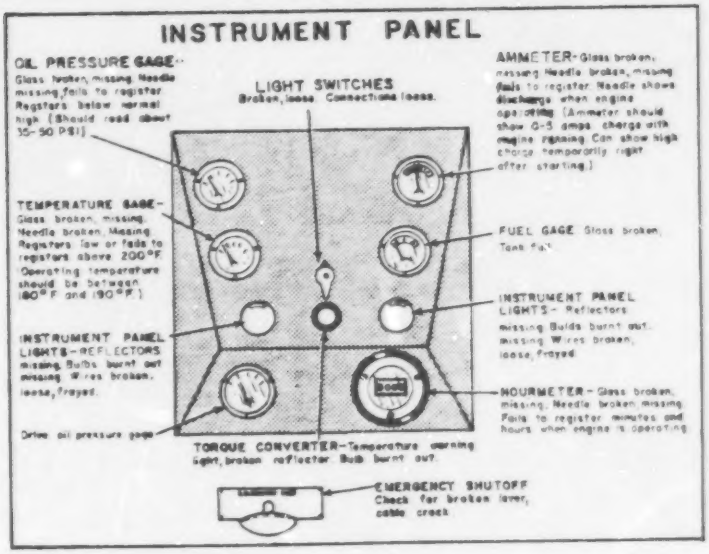
Work Unit 4-1. BEFORE-OPERATION CHECKS

IDENTIFY THE BEFORE-OPERATION CHECK OF CRANES AND THE EXCAVATOR.

IDENTIFY THE PERSON RESPONSIBLE FOR BEFORE-OPERATION CHECKS.

Before operating the crane and excavator, the operator should perform the following services to determine if the condition of the equipment has changed since it was last used, and to make sure that it is ready for operation. First make a complete 360° visual inspection of the entire crane or excavator; checking for cracks, breaks, broken electrical wires, leaks, and loose or missing bolts and nuts (fig 4-2). Next check the fuel supply to make sure the tank is full and refill if necessary. Then check the engine oil, hydraulic oil, coolant level, and add oil or coolant if necessary. Then, check all instruments for correct gauge readings (fig 4-3). Immediately after starting a cold engine, the air pressure gauge will indicate the amount of pressure in the air system. Pressure should remain between 70-100 PSI. Emergency breaks will apply automatically if pressure drops below 60 PSI on the Drott crane and excavator only. The oil pressure will be above normal; when the engine is warmed to operating temperature, the oil pressure may drop below normal at idling speed. these conditions are typical. If the oil pressure indicator shows no pressure, stop the engine at once and report this condition to your NCOIC. Next check for leaks, paying particular attention to the cooling system, hydraulic oil lines and fuel lines.


Cables frayed, not lubricated rusted.
Windows, cracked missing
Machinery Deck - Oily excess dirt, cluttered W/ containers, trash.
Lights (flood, marker, dome lights) Lenses dirty, broken, missing. Reflectors discolored.
Leaks, look for source of grease, oil slicks on ground or machinery


INSTRUMENT PANEL
OIL PRESSURE GAGE- Glass broken, missing. Needle missing, fails to register. Registers below normal high. (Should read about 35-50 PSI)
LIGHT SWITCHES Broken, loose. Connections loose.
AMMETER- Glass broken, missing Needle broken, missing fails to register Needle shows discharge when engine operating (Ammeter should show 0-5 amps charge with engine running. Can show high charge temporarily right after starting.)
TEMPERATURE GAGE- Glass broken, missing. Needle broken, Missing. Registers low or fails to registers above 200°F Operating temperature should be between 180°F and 190°F)
FUEL GAGE Glass broken. Tank full
INSTRUMENT PANEL LIGHTS- REFLECTORS missing. Bulbs burnt out missing. Wires broken, loose, frayed.
INSTRUMENT PANEL LIGHTS- Reflectors missing. Bulbs burnt out. missing. Wires broken, loose, frayed.
HOURMETER- Glass broken, missing. Needle broken missing. Fails to register minutes and hours when engine is operating
Drive oil pressure gage
TORQUE CONVERTER- Temperature warning light, broken reflector. Bulb burnt out.
EMERGENCY SHUTOFF Check for broken lever, cable crack

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EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What should be done first, before starting the engine?

   a. Check the fuel
   b. Check the gauges
   c. 360° visual inspection
   d. Check the tires

2. Who is responsible for the before-operation check?

   a. NCOIC
   b. Operator
   c. Squad leader
   d. Mechanic

Work Unit 4-2. DURING-OPERATION CHECKS

IDENTIFY THE DURING-OPERATION CHECKS.

As the operator you are responsible for correcting and reporting any unusual sounds or oders, deficiencies in performance, or other signs of abnormal operation. During operation you should check all instruments and gauge readings frequently. Stop operation if the engine oil pressure indicator shows a drop in pressure or no pressure, or if the temperature gauge shows engine overheating. Next check the air system; pressure should remain between 70-100 PSI. Emergency brakes will apply automatically if pressure drops below 60 PSI on the Drott crane and excavator. Also check the cables on the cranes frequently for proper alignment on the drums. If cables cross-wind, stop operation and correct the alignment immediately. Remember: do not operate until the failure is corrected and reported.

EXERCISE: Answer the following question and check your response agsinst those listed at the end of this study unit.

1. What are the during-operation checks?

   a. Check all instruments and gauge readings.
   b. Check cables and drums that the cables are on.
   c. Check oil and air pressure.
   d. All of the above.

Work Unit 4-3. AFTER-OPERATION CHECKS

LIST THE FOUR AFTER-OPERATION CHECKS.

The operator must perform the following services: After any operating period and after each 8-hour interval of continuous operation, all deficiencies must be corrected before resuming operation. Move the machine to a safe area and park it on firm level footing. Avoid banks that could possibly cave in or low spots where heavy rain may wash out the footing. If the machine is to be left outside in freezing temperatures, place it on planking or concrete. Fill the fuel tank with clean fuel and check the coolant in the radiator to be sure it is at or near the overflow when the engine is at operating temperature. Add coolant if necessary. Change coolant if it is contaminated wth rust or dirt. If antifreeze is used, check the freezing point of the cooling system. When adding antifreeze, be sure to mix the solution thoroughly by running the engine. Remove all dirt and grease from the upper machinery and cab deck, also clean all windows. If freezing temperatures are expected, remove all mud and dirt from places where frozen material would interfere, such as under the lower superstructure. Mud and dirt in or on the outriggers, can interfere with the operation of the crane and excavator. Be sure that all tools and accessories assigned to the SL-3 are clean, serviceable, properly mounted, and stored. Check the mounting condition, the cleanliness, and the operation of all lights. Make a visual inspection of the entire crane and exacavator, checking for oil, fuel, and water leaks, loose or missing bolts, nuts, and pins, or broken parts. Inspect all cables for broken frayed strands. Check the batteries to ensure that they are securely mounted and that connections and filler caps are clean and tight. Before leaving the equipment, close all windows, remove the ignition keys, and close or lock the cab compartment doors bleed the air tank on the excavator.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What are the four after-operation checks?

   a. _____

   b. _____

   c. _____

   d. _____

2. When work has been completed, what action must the operator take BEFORE parking his crane or excavator?

   a. Let the air out of the tires
   b. Pull the emergency shut off lever
   c. Fill the equipment up with fuel
   d. Raise the boom to maximum height

3. If after operation the equipment is to be left outside in freezing temperatures, where should you park?

   a. On planking or concrete
   b. In dirt or sand
   c. In mud or gravel
   d. On grass or weeds

Work Unit 4-4. TROUBLE-SHOOTING PROCEDURES

IDENTIFY THE THREE PROCEDURES THAT THE OPERATOR MUST KNOW BEFORE TROUBLE-SHOOTING.

The most important link between the operator and the mechanic is the operator's ability to trouble-shoot or diagnose problems which may cause unsatisfactory operation or failure of various parts of the crane and excavator. The operator must be able to recognize the symptom, determine the cause, and apply the remedy. Table 4-1 provides troubleshooting information useful in diagnosing and correcting unsatisfactory operation or failure of the crane, excavator, and its components. Each symptom is followed by a list of probable causes and their possible remedies. Any problem that is beyond the scope of operator maintenance is indicated in the table by an asterisk. Corrective action beyond the operator's capability is to be accomplished only by personnel thoroughly trained in the proper level of maintenance. Troubleshooting and repair procedures for the equipment's engine are similar to those of other type engines.

Table 4-I. Trouble-shooting Chart

Malfunction	Probable Cause	Corrective Action
Outriggers will not operate	a. Fuse blown. b. Defective ignition c. Open or shorted circuit between ignition switch and outriggers lever microswitch. d. Control spools in three and four spool valves not closing. e. Relief valves stuck open	a. Replace blown fuse. b. Check for presence of voltage at ignition switch. Replace switch if defective. c. Check wiring for continuity. d. Check linkage to valve banks and spool travel. e. Refer to proper authority.
Outrigger cylinders will not move horizontally	a. Contacts across outrigger toggle switch shorted.	a. Place switch to BEAM position and check for continuity-if continuity exists, replace switch.
Individual outrigger cylinders will not move horizontally	a. Relay contacts defective b. Defective BEAM solenoid. c. Defective or dirty collector ring d. Push button switch defective.	a. With ignition switch OFF check for continuity across relay terminals 1 and 2-if no continuity, replace relay. b. Check as outlined for JACK solenoid. c. Inspect, clean or repair defective collector ring brushes. d. Check for continuity across switch terminals-if no continuity with button depressed, replace switch.
Outrigger cylinder will not move vertically	a. Open or shorted lead to outrigger toggle switch. b. Outrigger toggle switch defective. c. Open or shorted wiring between toggle switch and collector ring. d. Defective or dirty collector ring or brushes. e. Open or shorted wiring between collector ring and outrigger relays	a. Check lead for continuity. b. Check for continuity across switch, with switch in FLOAT position - if no continuity, replace switch. c. Check wire for continuity to swivel ring No. 7. d. Clean dirty ring or brushes. Check for continuity across collector ring and brushes.witch e. Check wiring for continuity.
Outriggers retract, but do not extend	a. Out/down microswitch defective or circuit broken. b. Linkage to control valve disconnected or out of adjustment. c. Relief valve in control valve stuck open.	a. Check circuit. Replace defective microswitch. b. Check and repair linkage. c. Refer to proper authority.

Table 4-1. Trouble-shooting Chart--continued

Symptom	Probable Cause	Possible Remedy
Cables twist during operation	Wire ropes not reeved correctly	Check reeving
	Slack in wire rope	Check operation
	Incorrect operation	Check operation
Cables jump sheaves	Wire ropes have too much slack	Check reeving
	Sheave flange worn	Replace sheave.
	Lifting a load when the boom is not spotted directly over the load	Spot the boom over the load before making the lift
Cables flatten out	Cable crossed on drum.	Wind the cables evenly and correctly on drums
	Cable too long, allowing cable to pile up on drum	Shorten the cable to proper length
Cables wear excessively	Cable sheaves stuck to shafts	Free sheaves and lubricate.
	Cables lack lubrication	Lubricate cables
Boom out of sequence	a. Improper operation b. Lack of lubrication c. Defective sequence valve or proportionator valve	a. Sequence boom b. Lubricate boom c. Refer to proper authority
Batteries lose charge	a. Low liquid level in batteries. b. Grounded battery cable c. Loose cables or broken battery terminal d. Grounded wiring e. Excessive use of starting motor or other electrical equipment f. Dirty battery top causing continued drain on battery g. Loosen alternator drive h. Faulty alternator or internal regulator i. Faulty battery	a. Service batteries b. Inspect cables for worn insulation. Tape or replace cable c. Inspect, clean and tighten or replace cable d. Check all wiring for damage. Repair as necessary. e. Recharge batteries f. Check for leakage on dirty battery top Clean battery and terminals. g. Tighten belt h. Replace alternator i. Test batteries Replace if necessary.
Hoist cylinders will not extend or retract	a. Insufficient oil b. Control valve not opening c. Defective pump or control valve.	a. Check oil level b. Check linkage and replace defective parts c. Refer to proper authority
Cylinders fail to hold or "drop" when control is actuated	a. Cylinder packings defective. b. Defective counterbalance valve	a. Replace cylinder b. Refer to proper authority
Cylinders respond slowly or erratically	a. Low oil supply or air in system b. Linkage to valve bent or out of adjustment c. Defective cylinder packing d. Leak in hydraulic swivel or main relief setting too low.	a. Check condition and supply of oil; bleed cylinders. b. Replace damaged or worn parts c. Replace cylinder d. Refer to proper authority

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What are the three procedures that the operator must know before trouble-shooting?

   a. Apply the remedy, treat for shock, and recognize the symptom.
   b. Recognize the symptom, determine the cause, and apply the remedy.
   c. Determine the weather, apply the remedy, and determine the cause.
   d. All of the above

2. Referring back to the trouble-shooting chart (Table 4-1), select the probable cause showing excessively worn cables.

   a. Cable too long
   b. Slack in wire rope
   c. Cable not reeved correctly
   d. Cables lack lubrication

Work Unit 4-5. LUBRICATION INSTRUCTIONS

IDENTIFY THE FIVE LUBRICANT SYMBOLS.

IDENTIFY THE PURPOSE OF THE LUBRICATION INSTRUCTIONS.

Some models of cranes and excavator may require more frequent lubrication than other models. Therefore, a lubrication instruction (LI) is published for each model of equipment. Figures 4-4 and 4-5 show the LI for a Crane Wheel-Mounted Model 15½WF (Pettibone). The LI's also show the name and location of each lubrication point, the symbol for the type of lubricant to be used, and the hourly interval when lubrication is to be used for each lubricant point. Figure 4-4 shows the key to the lubricant symbols, the hourly intervals, and the oil capacities.

LUBRICATION INSTRUCTION | **LI-07691A-15**

1 April 1995

CRANE, HYDRAULIC, WHEEL MOUNTED, FULL REVOLVING
MODEL 1581WF
NSN 3810-00-377-1464

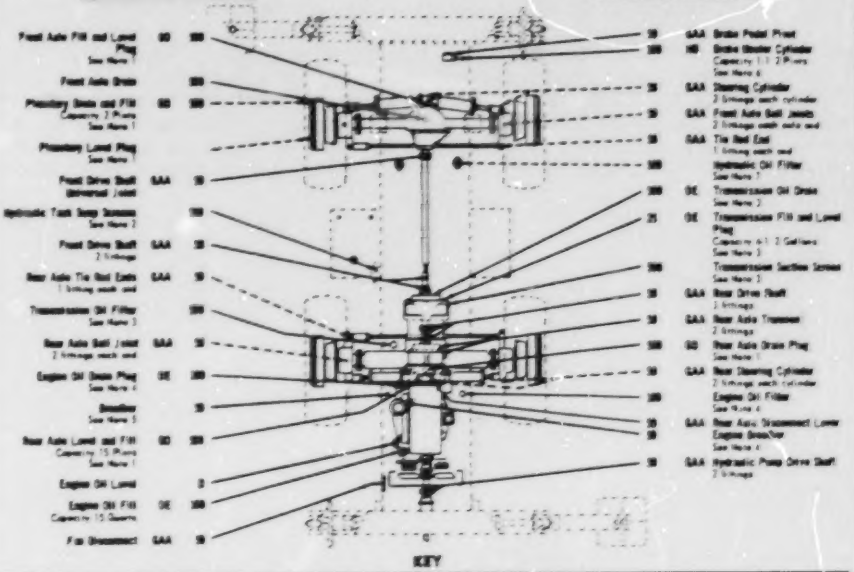
Reference: TM-07691A-15

Copy of this instruction to be carried with the equipment at all times. Dotted lines indicate lubrication points on both sides of equipment. Clean fittings before lubricating. Lubricate after washing equipment, frequent and lubricate more frequently under severe operating conditions. Lubricate as soon as practicable after exposure to salt water.

Equipment in storage or received direct from the manufacturer is normally preserved with special preservatives and lubricants. On removal of these, repack all components in accordance with this instruction prior to operation.

See reverse side of instruction for additional points requiring lubrication.

LUBRICANT ⊕ INTERVAL | **INTERVAL ⊕ LUBRICANT**



KEY

SYMBOL	LUBRICANT AND APPLICATION	EXPECTED TEMPERATURES			INTERVALS		NOTES
		ABOVE +32°F	+0 to 0°F	-10 to -65°F	SYMBOL	INTERVAL	
OE	OIL, Engine Engine crankcase and oil cap points	SAE 30 MIL-L-2104	SAE 10 MIL-L-2104	OES Lubricating Oil, Internal Combustion Engine, Arctic MIL-L-46167	D	Daily	
	OIL, Engine Transmission and hydraulic system	SAE 10 MIL-L-2104			25	25 hours	
					50	50 hours	
GAA	GREASE, Automotive and Artillery General fittings, wire rope and boom	MIL-G-10924			100	100 hours	
					250	250 hours	
GO	OIL, Gear Axles, planetaries, ball joints and tie rods	GO 90 MIL-L-2105			500	500 hours	
	OIL, Gear Swing gearcase	NBM Lower Cylinder FED SPEC VV-L-795 GR2					
SD	SOLVENT, Dry Cleaning Extension of boom and boom extension	FED SPEC P-D-680					
HB	FLUID, Hydraulic Brake Master cylinder	FED SPEC VV-B-680		HBA MIL-H-13910			

Fig 4-4. Lubrication Instructions.

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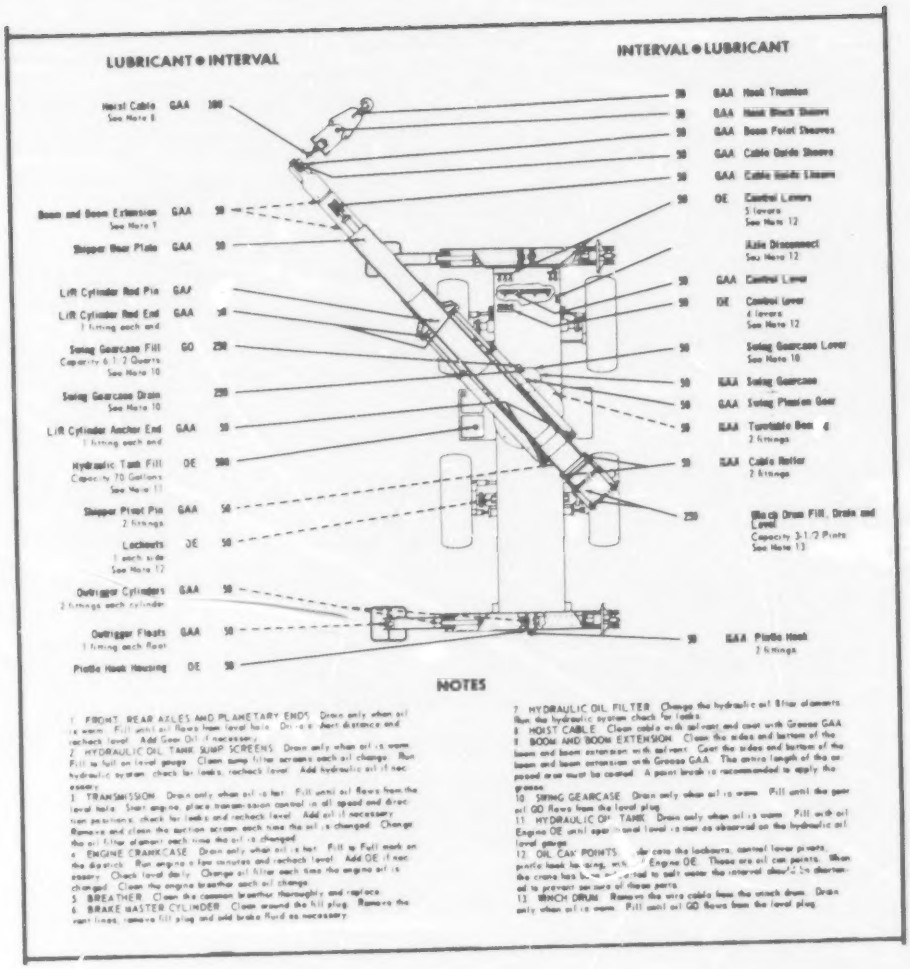
LUBRICANT • INTERVAL
INTERVAL • LUBRICANT
Hoist Cable See Note 8 GAA 100
Boom and Boom Extension See Note 1 GAA 50
Stopper Shaft Plate GAA 50
Lift Cylinder Rod Pin GAA
Lift Cylinder Rod End 1 fitting each end GAA 50
Swing Gearcase Fill Capacity 6-1/2 Quarts See Note 10 GO 250
Swing Gearcase Drain See Note 10 250
Lift Cylinder Anchor End 1 fitting each end GAA 50
Hydraulic Tank Fill Capacity 70 Gallons See Note 11 OE 500
Stopper Pivot Pin 2 fittings GAA 50
Lockouts 1 each side See Note 12 OE 50
Outrigger Cylinders 2 fittings each cylinder GAA 50
Outrigger Floats 1 fitting each float GAA 50
Pintle Hook Housing OE 50
50 GAA Hook Trunnion
50 GAA Hook Block Sheave
50 GAA Boom Point Sheaves
50 GAA Cable Guide Sheave
50 GAA Cable Guide Sheave
50 OE Control Levers 5 levers See Note 12
Axle Disconnect See Note 12
50 GAA Control Lever
50 OE Control Lever 4 levers See Note 12
50 Swing Gearcase Lever See Note 10
50 GAA Swing Gearcase
50 GAA Swing Planetary Gear
50 GAA Turntable Bear 4 2 fittings
50 GAA Cable Roller 2 fittings
250 Winch Drum Fill, Drain and Level Capacity 3-1/2 Pints See Note 13
50 GAA Pintle Hook 2 fittings

NOTES

1. FRONT, REAR AXLES AND PLANETARY ENDS. Drain only when oil is warm. Fill until oil flows from level hole. On rear, dust distance and recheck level. Add Gear Oil if necessary.
2. HYDRAULIC OIL TANK SUMP SCREENS. Drain only when oil is warm. Fill to full on level gauge. Clean sump filter screens each oil change. Run hydraulic system, check for leaks, recheck level. Add hydraulic oil if necessary.
3. TRANSMISSION. Drain only when oil is hot. Fill until oil flows from the level hole. Start engine, place transmission control in all speed and direction positions, check for leaks and recheck level. Add oil if necessary. Remove and clean the suction screen each time the oil is changed. Change the oil filter element each time the oil is changed.
4. ENGINE CRANKCASE. Drain only when oil is hot. Fill to Full mark on the dipstick. Run engine a few minutes and recheck level. Add OE if necessary. Check level daily. Change oil filter each time the engine oil is changed. Clean the engine breather each oil change.
5. BREATHER. Clean the common breather thoroughly and replace.
6. BRAKE MASTER CYLINDER. Clean around the fill plug. Remove the vent lines, remove fill plug and add brake fluid as necessary.
7. HYDRAULIC OIL FILTER. Change the hydraulic oil filter elements. Run the hydraulic system check for leaks.
8. HOIST CABLE. Clean cable with solvent and coat with Grease GAA.
9. BOOM AND BOOM EXTENSION. Clean the sides and bottom of the boom and boom extension with solvent. Coat the sides and bottom of the boom and boom extension with Grease GAA. The entire length of the extension must be coated. A paint brush is recommended to apply the grease.
10. SWING GEARCASE. Drain only when oil is warm. Fill until the gear oil GO flows from the level plug.
11. HYDRAULIC OIL TANK. Drain only when oil is warm. Fill with oil Engine OE until operational level is seen as observed on the hydraulic oil level gauge.
12. OIL CAN POINTS. Air core the lockouts, control lever points, pintle hook latch spring, etc. Engine OE. These are oil can points. When the crane has been operated in salt water the internal should be thoroughly flushed to prevent seizure of these parts.
13. WINCH DRUM. Remove the wire cable from the winch drum. Drain only when oil is warm. Fill until oil GO flows from the level plug.

Fig 4-5. Lubrications Instructions.

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EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What are the five symbols used for lubricant and application?

   a. OE, GAA, TI, SL, GO
   b. OE, TI, LI, GAA, GO
   c. OE, GAA, GO, SD, HB
   d. OE, GAA, GO, SD, LI

2. What is the publication that gives specific instructions for the lubrication of each model crane and excavator?

   a. TI
   b. TE
   c. LI
   d. SL

3. What do the lubrication instructions show?

   a. Lifting capacity
   b. Rated horsepower
   c. Boom angles
   d. Each lubrication point

Work Unit 4-6. LUBRICATION PRECAUTIONS

STATE THE SIX LUBRICATION PRECAUTIONS.

WHEN OPERATING A CRANE OR EXCAVATOR IN EXTREMELY DIRTY AREAS, SUCH AS SANDY OR DUSTY ENVIRONMENTS, IDENTIFY WHEN MAINTENANCE IS DUE ON THE CRANE.

Don't guess! Always use the lubrication instructions. Remember, however, that the lubrication instructions are based on average operating conditions. In some cases it may be necessary to change oil or lubricate your crane and excavator after shorter operating periods than those given in the lubrication instructions. Some instances are operating in extremely dusty areas, and continually lifting near-maximum-capacity loads. In addition to using the lubrication instructions as a guide when lubricating your crane and excavator, you should also observe the following precautions:

Keep all lubricants in clean, airtight containers

Use the right grease stated in the LI

Make sure that all lube fittings are open and clear of obstructions. If a fitting is clogged, remove and clean, or replace it.

Be careful not to over lubricate when using an air pressure type grease gun. Always use a low pressure, hand operated gun for lubricating low pressure fittings.

Wipe fitting clean before and after lubrication

Always stop the engine before lubricating your crane and excavator

If you remember these important points, follow the lubrication instructions, and use good judgment when lubricating your crane and excavator, you should have little trouble keeping it well lubricated and ready for use.

You should find the lubrication instructions for a particular crane and excavator reproduced in the equipment's technical manual. In addition, a copy of the LI, sealed in plastic, should be carried aboard the equipment at all times. If you do not have the correct LI on hand for your equipment, you should order it immediately through the supply system.

EXERCISE: Answer the following questions and check your responses against those listed at the end of this study unit.

1. What are the six lubrication precautions?

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

2. What should you check for before lubricating the equipment?

   a. LI sealed in plastic
   b. Tire pressure
   c. Headlights working
   d. Fuel in the tank

3. When operating in extremely dusty areas, when should you change the oil and lubricate your crane and excavator?

   a. Less frequently than recommended in the LI
   b. More frequently than recommended in the LI
   c. Only after the job is completed
   d. In strict accordance with the LI

SUMMARY REVIEW

In this lesson, you learned to identify before-operation, during-operation, and after-operation checks. In addition, you learned to identify troubleshooting procedures, lubrication instruction, and safety precautions.

Answers to Study Unit #1 Exercises

Work Unit 4-1.

1. c
2. b

Work Unit 4-2.

1. d

Work Unit 4-3.

1. a. Check the of lights.
   b. Check the fuel, oil and water levels.
   c. Check for broken or frayed cables.
   d. Check the batteries.
2. c
3. a

Work Unit 4-4.

1. b
2. d

Work Unit 4-5.

1. c
2. c
3. d

Work Unit 4-6.

1. a. Keep all lubricants clean.
   b. Use the right grease and oil stated in the LI.
   c. Make sure all lube fittings are clean.
   d. Be careful not to overlubricate.
   e. Wipe fittings clean before and after lubrication.
   f. Always stop the engine before lubricating the equipment.
2. a
3. b

CRANE AND EXCAVATOR OPERATOR

Review Lesson

INSTRUCTIONS: This review lesson is designed to aid you in preparing for your final exam. You should try to complete this lesson without the aid of reference materials, but if you do not know an answer look it up and remember what it is. The enclosed answer sheet must be filled out according to the instructions on its reverse side and mailed to MCI using the envelope provided. The questions you miss will be listed with references on a feedback sheet (MCI-R69) which will be mailed to your commanding officer with your final exam. You should study the reference material for the questions you missed before taking the final exam.

A. Multiple Choice: Select the ONE answer that BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

1. What is the primary purpose of a crane?

   a. To build bridges
   b. To lift loads and place them in new locations
   c. To carry loads over long distances
   d. To dig ditches

2. What are the two basic components of a crane and excavator?

   a. Mounting carrier and upper superstructure
   b. Wheel-mount and winch
   c. Truck-mount and boom
   d. Air-mount and tires

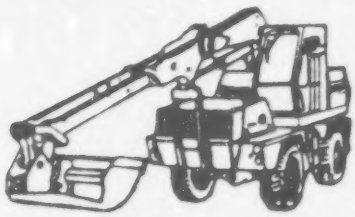
B. Matching: Match each illustration in column 1 (items 3-6) with its appropriate nomenclature in column 2. Select the one letter (a, b, c, d, or e) indicating your choice. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

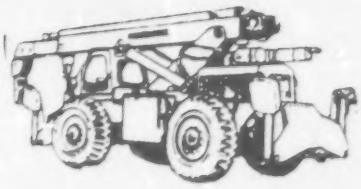
Column 1

Illustration

3.



4.



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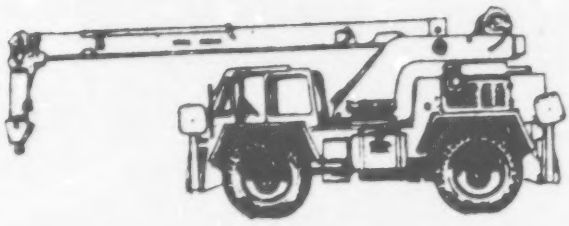
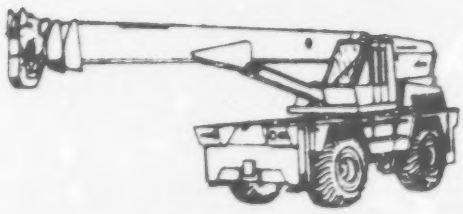


6.



Column 2

Nomenclature

a. M-1581WF 7 1/2-ton (Pettibone)
b. M-315T (P&H)
c. MC2500 30-ton (Drott)
d. M-RT-48MC 7 1/2-ton (Grove)
e. MC40 Cruz (Drott)

C. Multiple Choice: Select the ONE answer which BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

7. What is the horizontal distance from the center of the crane's turntable to the center of the hook block suspended over the load called?

a. Operating radius
b. Boom angle
c. Boom length
d. Operating length

8. The lifting capacity of a crane is rated by _____

a. boom length and boom angle.
b. operating radius, boom angle, and boom length.
c. boom length, boom angle, and tipping.

9. How is boom angle determined?

   a. When the boom is raised from vertical position
   b. When the boom is raised from horizontal position
   c. When the boom is lowered to the ground
   d. When the boom is raised 75°

10. What is meant by operating radius?

   a. Horizontal distance from the center of the crane's turntable to the center of the hook block
   b. Vertical distance from the center of the crane's turntable to the center of the hook block
   c. The load to the crane
   d. The boom to the load

D. Questions 11-16 require you to select the answers from the Safe Load Data Chart below.

Value: 1 point each

Working radius in feet (1)	Boom length in feet (2)	Boom elevation in degrees to obtain working radius	Safe lifting capacity in pounds with outrigger (3)	Safe lifting capacity in pounds without outrigger (4)
10	20	51	15,000	7,000
10	30	64	15,000	7,000
10	40	71	15,000	7,000
15	20	28	11,500	5,000
15	30	52	11,500	5,000
15	40	63	11,500	5,000
20	30	39	6,750	3,250
20	40	54	6,750	3,250
25	30	17	4,500	2,120
25	40	45	4,500	2,120
30	40	33	3,775	1,200
36	40	0	2,300	650

Safe Load Data Chart.

11. What is the safe lifting capacity with outriggers when the working radius is 10 ft, boom length is 40 ft, and boom elevation is 71°?

   a. 11,500
   b. 12,000
   c. 13,500
   d. 15,000

12. What is the safe lifting capacity with outriggers when the working radius is 15 ft, boom length is 20 ft, and boom elevation is 28°?

   a. 15,000
   b. 6,750
   c. 11,500
   d. 4,500

13. What is the safe lifting capacity with outriggers when the working radius is 30 ft, boom length is 40 ft, and boom elevation is 33°?

   a. 3,775
   b. 4,500
   c. 6,750
   d. 11,500

14. What is the safe lifting capacity without outriggers when the working radius is 10 ft, boom length is 40 ft, and boom elevation is 71°?

    a. 11,500
    b. 15,500
    c. 7,000
    d. 5,000

15. What is the safe lifting capacity with outriggers when the working radius is 36 ft, and boom length is 40 ft, and boom elevation is 0°?

    a. 6,750
    b. 4,500
    c. 3,775
    d. 2,300

16. What is the safe lifting capacity without outriggers when working radius is 25 ft, and boom length is 30 ft, and boom elevation is 17°?

    a. 15,000
    b. 2,300
    c. 11,500
    d. 2,120

E. Questions 17-21 require you to select the answers from the Rated Load Chart below.

Value: 1 point each

RATED LIFTING CAPACITIES
33'-80' 3-SECTION FULL POWER TELESCOPING BOOM
MAXIMUM RATED LOADS 360° - OUTRIGGERS DOWN

Working Radius	BOOM LENGTH 33		38		44		50		56		62		68		74		80	
10	72°	80000	74°	55000	77°	50000												
12	68°	80000	71°	50000	74°	47500	76°	45000										
15	62°	50000	66°	47500	70°	45000	72°	40000	74°	38000	76°	34500						
20	51°	37000	57°	37000	62°	37000	66°	34000	69°	32000	71°	30000	73°	28000	74°	23000	75°	20000
25	38°	28500	47°	28500	54°	28500	59°	28500	63°	28000	66°	25000	68°	23500	70°	21500	72°	18500
30	15°	21500	34°	21500	45°	21500	52°	21500	57°	21500	60°	21000	63°	20000	66	18500	68°	17000
35			10°	16500	34°	16500	44°	16500	50°	16500	55°	16500	58°	16500	61°	15500	64°	14500
40					17°	13000	34°	13000	43°	13000	49°	13000	53°	13000	57°	13000	60°	12000
45							20°	10500	34°	10500	42°	10500	48°	10500	52°	10500	55°	10000
50									22°	9000	34°	9000	41°	9000	47°	9000	51°	9000
55											24°	7500	34°	7500	41°	7500	46°	7500
60													25°	6500	34°	6500	40°	6500
65													7°	5500	26°	5500	34°	5500
70															12°	4500	27°	4500
75																	16°	4000
77																	6°	3500

RATED LIFTING CAPACITIES
33'-80' 3-SECTION FULL POWER TELESCOPING BOOM
MAXIMUM RATED LOADS OVER FRONT-OUTRIGGERS DOWN

Working Radius	BOOM LENGTH 33		38		44		50		56		62		68		74		80	
10	72°	80000	74°	55000	77°	50000												
12	68°	80000	71°	50000	74°	47500	76°	45000										
15	62°	50000	66°	47500	70°	45000	74°	36000	76°	34500								
20	51°	37000	57°	37000	62°	37000	66°	34000	69°	32000	71°	30000	73°	28000	74°	23000	75°	20000
25	38°	28500	47°	28500	54°	28500	59°	28500	63°	28000	66°	25000	68°	23500	70°	21500	72°	18500
30	15°	22500	34°	22500	45°	22500	52°	22500	57°	22000	60°	21000	63°	20000	66°	18500	68°	17000
35			10°	18500	34°	18500	44°	18500	50°	18500	55°	17500	58°	17000	61°	15500	64°	14500
40					17°	16000	34°	15500	43°	15500	49°	15000	53°	15000	57°	13000	60°	12000
45							20°	13000	34°	13000	52°	13000	48°	13000	52°	11000	55°	11000
50									22°	11500	34°	11500	41°	11500	47°	10000	51°	9000
55											24°	10000	34°	10000	41°	9000	46°	7500
60													25°	8000	34°	8000	40°	6500
65													7°	7500	26°	7500	34°	6000
70															12°	6500	27°	5500
75																	16°	5000
77																	6°	4000

17. On rated loads of 360°, what is the maximum rated load for a boom length of 68 ft with a boom angle of 63° and operating radius of 30 ft, outriggers down?

a. 20,000
b. 30,000
c. 30,500
d. 40,000

18. On rated loads of 360°, what is the maximum rated load for a boom length of 44 ft, a boom angle of 54°, and operating radius of 25 ft, outriggers down?

a. 28,500
b. 28,750
c. 28,000
d. 25,000

19. On rated loads of 360°, what is the maximum rated load for a boom length of 74 ft, a boom angle of 41°, and operating radius of 55 ft, outriggers down?

a. 7,500
b. 10,000
c. 13,000
d. 15,000

20. On rated loads over front of the crane, the maximum rated load for a boom length of 44 ft, a boom angle of 45°, and operating radius of 30 ft is _____

a. 13,000
b. 21,000
c. 22,500
d. 50,000

21. On rated loads over front of the crane, what is the maximum rated load for a boom length of 62 ft, a boom angle of 49°, and an operating radius of 40 ft?

a. 10,000
b. 19,500
c. 13,000
d. 15,000

F. Multiple Choice: Select the ONE answer which BEST completes the statement or answers the question. After the corresponding number on the answer sheet blacken in the appropriate circle.

Value: 1 point each

22. Before attempting to ford a stream with the MC2500 crane, you should always insure that the water is no deeper than the _____.

a. top of the counterweight
b. top of the tires
c. bottom of the superstructure
d. bottom of the operator's seat

23. The M-1581WF crane can ford a depth of how many inches?

a. 80
b. 70
c. 48
d. 50

24. What is the fording capability of the Drott Excavator?

a. 60
b. 50
c. 40
d. 30

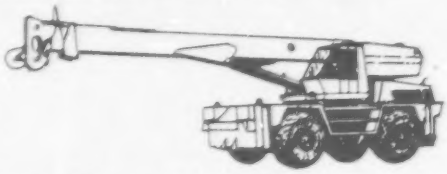
25. What is a carrier mobility trait of the Drott Excavator?

a. Truck-mounted
b. Ski-mounted
c. Track-mounted
d. Wheel-mounted

26. What is a carrier mobility trait of all three cranes?

a. Wheel-mounted
b. Ski-mounted
c. Track-mounted
d. Truck-mounted

27. What attachment fits the crane in this illustration?

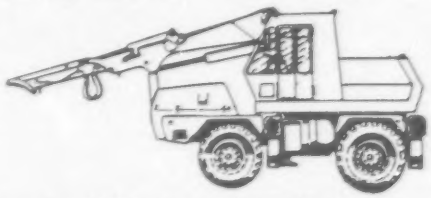


a. Hook Block
b. Dragline
c. 4-in-1 Drott
d. forks

28. The purpose of the hook block attachment is to

a. lift anything weighing up to the capacity rating of the crane.
b. knock piles into the ground.
c. drag.
d. dig ditches.

29. What attachment can fit the excavator in this illustration?



a. 4-in-1 Drott
b. Hook block
c. Dragline
d. Pile driver

30. What is the purpose of the multipurpose bucket?

a. To be used as a bulldozer
b. To be used as a scraper & clamshell
c. To be used as a front-end loader
d. All of the above

31. Select the attachment that fits this crane.

a. Pile driver
b. forks
c. Hook block
d. Dragline

32. The advantage of the ditch cleanout bucket w/wrist-o-twist is that it

a. has dragline capabilities.
b. can lift objects.
c. can drive piles.
d. has a more efficient cleaning action.

33. What attachment does not belong to the Drott 40 Cruz air excavator?

a. 4-in-1 Drott
b. Wrist-o-twist
c. Auger
d. Ditch digging bucket

34. The purpose of the clamshell attachment is to

a. work at above, or on top ground level.
b. work at above, or below ground level.
c. work only on top of the surface.
d. All of the above

35. What attachment does not belong to the Drott MC2500 crane?

a. Pile driver
b. Hook block
c. Clamshell
d. 4-in-1 Drott

36. The purpose of the pile driver attachments is to

a. lift loads.
b. excavate swamps.
c. drive wood, steel & concrete pilings.
d. dig ditches.

37. Which attachment belongs to the Grove crane?

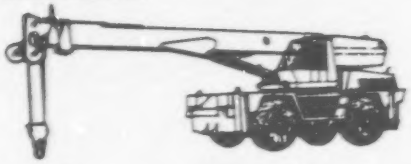
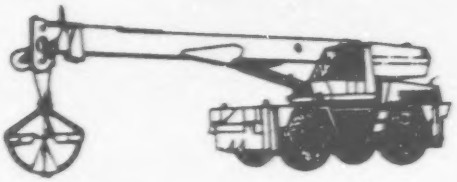
a. Hook block
b. Pile driver
c. Clamshell
d. Dragline

38. The purpose of the excavator bucket is

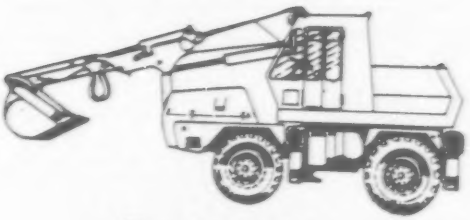
a. loading aggregate.
b. digging pits.
c. excavating quarries.
d. digging trenches.

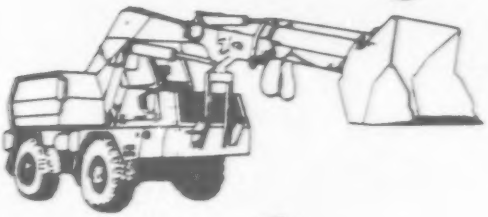
G. Matching: Match the name of each attachment in column 1, group 1 (39-41)and group 2 (42-44), with its correct illustration in column 2. For each item, select the ONE letter (a, b, c, d, or e) indicating your choice. After the corresponding number on the answer sheet, blacken the appropriate circle.

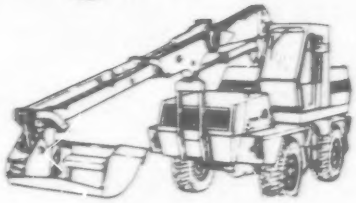
Value: 1 point each

Column 1	Column 2
Group 1	Illustrations
39. Pile Driver	a. 
40. Hook Block	
41. Clamshell	
Group 1	
42. Ditch cleanout bucket w/wrist-o-twist	b. 
43. Multipurpose	
44. Excavator Bucket	

c.

a. 

b. 

c. 

H. Multiple Choice: Select the ONE answer that BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

45. What are the three parts of wire rope?

a. Wire, rope, and core
b. Core,oil, and wire
c. Strands, core, and string
d. Wire, strands, and core

46. What specific measurement would you use to determine the width, distance, and number of seizings?

a. The number of strands in wire rope
b. The diameter of the wire rope
c. The length of the wire rope
d. The number of wires in a wire rope

47. What is the definition of seizing (wire rope)?

a. Process of melting two ends together
b. Process of fitting it around the right sheave
c. Process of cutting wire rope before tying
d. Process of securing or tying off wire rope before cutting

48. What two devices are used for cutting wire rope?

a. Ax and scissors
b. Hydraulic cutter and oxyacatylene torch
c. Hydraulic cutter and welder
d. File and chisel

49. Which of the following two causes will shorten the life of wire rope?

a. Continuous use and lubrication
b. Reeving the wrong way and lack of lubrication
c. Lubrication lack of use
d. Not using it and storing it in a cool place

50. How often should cranes and excavators be load-tested?

a. Quarterly
b. Semi-annually
c. Weekly
d. Annually

51. When lifting loads, it is safer to lift on

a. quagmire.
b. stable ground.
c. soft ground.
d. wet ground.

52. When are lifting capacities reduced?

a. When a boom length exceeds normal standard boom length
b. When a boom width exceeds normal standard boom width
c. When a boom weight exceeds normal standard boom weight
d. When a cable weight exceeds normal standard cable weight

53. A jib attached to the boom provides greater

a. boom strength.
b. lift.
c. horizontal reach.
d. vertical reach.

54. If a crane operator attempts to pick up a maximum load from the side of the crane, what will happen?

a. Crane will shoot
b. Tipping may occur
c. Tires may go flat
d. The cable will break

I. Matching: Match each of the hand signals in column 1, group 1 (55-59), group 2 (60-64), group 3 (65-69), and group 4 (70-74) with its proper illustration in column 2. For each item in each of the 4 groups, select the one letter (a, b, c, d, or e) indicating your choice. After the corresponding number or the answer sheet, blacken the appropriate circle.

Value: 1 point each

Column 1

Group 1

55. Lower the boom slowly
56. Raise the boom slowly
57. Raise a little
58. Lower the boom and hold the load
59. Raise the boom

Column 2

Illustration

a.

b.

c.

d.

e.

Column 1	Column 2
Group 2	Illustration
60. Stop	a.
61. Swing in direction	
62. Lower slowly	
63. Lower the load	
64. Raise the boom and lower the load	b.

c.

d.

e.

Column 1	Column 2
Group 3	Illustration
65. Raise or hoist slowly	a.
66. Open bucket	
67. Raise the load	
68. Lower the boom and raise the load	
69. Lower the boom	

b.

c.

d.

e.

Column 1	Column 2
Group 4	Illustration
70. Emergency stop	a.
71. Maneuver forward slow and easy	
72. Raise the boom and hold the load	b.
73. Lower a little	
74. Close bucket	c.
	d.

e.

J. Multiple Choice: Select the ONE answer which BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

75. When working near a power line what should you do?

a. Cut the wires.
b. Test the wires to see if they are still alive.
c. Notify the power company to de-energize the lines.
d. It doesn't matter what you do.

76. When operating near power lines, who should you have with you?

a. An electrician
b. A Plumber
c. An instructor
d. A signalman

77. How many men should perform crane operations?

a. 4
b. 3
c. 2
d. 1

K. Questions 78-80 Pertain to the User's Safety Booklet

Value: 1 point each

78. When using outriggers, why would you extend all beams completely?

a. For maximum stability
b. For minimum stability
c. For soft ground
d. For hilly ground

79. When you arrive at the job site with the crane or excavator, you should

a. pay attention to the weather.
b. pay attention to the person doing the job.
c. take the job site for granted.
d. have enough room to maneuver in.

80. You should never swing or position a hook or load over the

a. ground crew or truck cab.
b. ground crew or field.
c. rear end of the dump truck.
d. scraper or pond.

L. Multiple Choice: Select the One answer which BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

81. Who is responsible for making before-, during-, and after- operation checks on a crane?

a. Unit mechanic
b. Operator
c. Maintenance chief
d. Operations chief

82. Before-, during-, and after-operation inspections are performed to insure that

a. operators become familiar with their equipment.
b. quarterly preventive maintenance will not be needed.
c. defects are discovered and corrected before they cause serious damage failure.
d. operators are familiar with the area in which they are required to operate.

M. Matching: In the group of items below (items 83-87), match the operational checks in column 1 with the time when they are to be done in column 2. Select the ONE letter (a, b, or c), indicating your choice. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

Column 1	Column 2
Operational check	When done
83. Oil level	a. Before operation
84. Remove ignition keys	b. During operation
85. Temperature gauge	c. After operation
86. Broken wires	
87. Unusual noises	

N. Multiple Choice: Select the ONE answer which BEST completes the statement or answers the question. After the corresponding number on the answer sheet, blacken the appropriate circle.

Value: 1 point each

88. Recognizing a sympton, determining its cause, and applying a remedy are the basic procedures for

a. performing a before operation inspection.
b. performing weekly preventive maintenance.
c. troubleshooting malfunctions.
d. load testing a crane.

89. What does OE stand for?

a. Other engines
b. Engine oil
c. Oily equipment
d. Oil engine

90. What is the symbol for Oil Gear?

a. GAA
b. GO
c. OG
d. HB

91. What does GAA stand for?

a. Automotive Grease
b. Grease Automotive and Artillery
c. Gear oil
d. Hydraulic Brake

92. What does the symbol HB stand for?

a. Hydraulic Brake Fluid
b. Hydraulic Batteries
c. Hydrogen Fluid
d. Brake bands.

93. What is the symbol for Solvent Dry Cleaning?

a. SAE
b. OES
c. SD
d. HB

94. When operating in adverse conditions, such as in extremely high or low temperatures or in extremely dusty areas, when should you lubricate your crane and excavator?

a. More frequently than recommended in the LI
b. Less frequently than recommended in the LI
c. In strict accordance with the LI
d. Only after the job is completed

95. Before lubricating your crane and excavator, you should always insure that you have the proper TM and

a. SL.
b. LI.
c. FM.
d. TI.

Total Points: 95

* * *

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T&E-1

STUDENT COURSE CONTENT ASSISTANCE REQUEST

DATE:

COURSE NUMBER COURSE TITLE

NAME RANK MOS

SOCIAL SECURITY NUMBER

1. Use this form for any questions you may have about the course. Write out your question and refer to the study unit, work unit, or study question with which you are having problems. Complete the self-addressed block on the reverse side. Before mailing, fold the form and staple it so that MCI's address is showing. Additional sheets may be attached to this side of the form.

MY QUESTION IS: OUR ANSWER IS:

SIGNATURE (TITLE OR RANK)

STUDENT: Detach and retain this portion.

DATA REQUIRED BY THE PRIVACY ACT OF 1974
(5 U.S.C. 522A)

1. AUTHORITY: Title 5, USC, Sec. 301. Use of your Social Security Number is authorized by Executive Order 9397 of 22 Nov 43.

2. PRINCIPAL PURPOSE: The Student Course Content Assistance Request is used to transmit information concerning student participation in MCI courses.

3. ROUTINE USE: This information is used by MCI personnel to research student inquiries. In some cases information contained therein is used to update correspondence courses and individual student records maintained by the Marine Corps Institute.

4. MANDATORY OR VOLUNTARY DISCLOSURE AND EFFECT ON INDIVIDUAL NOT PROVIDING INFORMATION: Disclosure is voluntary. Failure to provide information may result in the provision of incomplete service to your inquiry. Failure to provide your Social Security Number will delay the processing of your assistance request.

INSTRUCTIONS TO STUDENT

1. Fold so that MCI address is outside
2. Insert course number in square marked "Course Number" below
3. Seal with scotch tape or one staple
4. Mail to MCI

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 12466 WASHINGTON D. C.

POSTAGE WILL BE PAID BY U.S. MARINE CORPS

UNITED STATES MARINE CORPS
MARINE CORPS INSTITUTE
P. O. BOX 1775
ARLINGTON, VA 22222

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

STUDENT REQUEST/INQUIRY
MCI - R14 X

DATE SENT: _____
DATE RECEIVED AT MCI: _____

COURSE NUMBER	COURSE TITLE

COMPLETE ALL PORTIONS OF SECTION 1

Section 1. Student Identification

Rank	Initials	Last Name	MOS

SSN | | | | — | | | — | | | | |

REPORTING UNIT CODE (RUC)

MILITARY ADDRESS

ZIP CODE

INSTRUCTIONS: Print or type name, rank, and address clearly. Include ZIP CODE. Only Class III Reservists may use civilian address.

Section 2. CHECK THE APPROPRIATE BOX AND FILL IN THE APPROPRIATE SPACES.

FOR REGULAR AND CLASS II RESERVE MARINES THIS FORM MUST BE SIGNED BY THE COMMANDING OFFICER OR HIS REPRESENTATIVE, i.e. TRAINING NCO.

1. ☐ EXTENSION - Please grant an extension. (Will not be granted if already on extension.)

2. ☐ NOTICE OF COURSE COMPLETION - Final Exam Sent On _____. (New exam will be sent if exam not received at MCI.)

3. ☐ REENROLLMENT - Student has course materials (See para. 4003 of Vol. 1 of MCI Catalog for information on reenrollment.)

4. ☐ OVERDUE FINAL EXAM - Last (Review) lesson sent on _____. Please send exam.

5. ☐ Please send new ANSWER SHEETS.

6. ☐ Please send missing course materials (Not included in course package.)
Lessons____ Manual_____ Other_____

7. ☐ CHANGE - Rank_____ Name _____
Social Security Number ☐☐☐-☐☐-☐☐☐☐
RUC _____

8. ☐ OTHER (explain)_____

_____

Note: This form will not be returned by MCI. If request is valid, transaction will show on next UAR or on MCI-R1_ form.

_____
SIGNATURE-TITLE OR RANK
(MUST BE CO OR REPRESENTATIVE)

FOR MCI USE ONLY

1. D____
2. On SMF___ K___ L ____
3. C____
4. L____
5. Q____
6. P____
7. E____
8. _____

DATE COMPLETED_____

ORIGINATOR CODE_____

STUDENT: Detach and retain this portion.

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